AN

ACCOUNT

OF THE

Discoveries concerning Comets,

WITH

The Way to find their Orbits,

And some Improvements

In constructing and calculating their Places.

For which Reason are here added

New TABLES, fitted to those Purposes;

Particularly with regard to

That COMET *which is soon expected to return.*

By THOMAS BARKER, Gent.

JOB XXVI. 14. *Lo, these are a part of his ways: but how little a portion is heard of him!*

SEN. Quæst. Nat. Lib. VII. 31. *Multa seculis tunc futuris, cum memoria nostri exoleverit, reservantur. Pusilla res mundus est, nisi in illo quod quærat omnis mundus habeat.*

LONDON,

Printed for J. WHISTON and B. WHITE, in *Fleet-Street.*

MDCCLVII.

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THE
PREFACE.

THAT bright comet, which was ſeen in 1744, *having raiſed in me as well as others a greater curioſity about them; I had once thoughts of undertaking a kind of hiſtory of comets, which, beſide what is given here, ſhould contain an improvement of Hevelius's and Lubienietz's accounts of the ancient ones, and a continuation of them to the preſent time. The alterations I deſigned to make were theſe: Firſt, To leave out the aſtrological obſervations, which the old authors, looking on comets chiefly as prodigies, are full of, and Lubienietz's book is almoſt all ſo; to quote nothing but what relates to the comet itſelf; and in later times, when there are many accounts of the ſame comet, to inſert the principal, and perhaps paſs over ſome of them which contained nothing new. Secondly, Hevelius and Lubienietz take many comets only ſecond hand, from Rockenbach and other modern writers, but I would as much as poſſible have quoted the original authors. Thirdly, Different perſons not uſing the ſame chronology, have often made ſeveral comets of one. Thus the four Seneca reckons up* Nat. Quæſt. VII. 17. *after the death of Julius Cæſar, under Auguſtus, Claudius, and Nero, are in Hevelius increaſed to thirteen; and the two laſt of them, which he calls the two comets ſeen in our time* VII. 23. *Lubienietz has made eight of. Fourthly, Lubienietz ſwells his hiſtory with balls of fire, northern lights, and perhaps other meteors: all theſe, as alſo multiplying of real comets, I deſigned to have avoided where I could. In purſuit of this deſign, I made a liſt of the comets which had been ſeen, with references to the authors who mentioned them, ſo far as I had then found, leaving room to add more, as I met with them; and began to draw up the account of a few of the firſt with the authorities, but found ſo little ſatisfaction from the very imperfect accounts, that perceiving the benefit would not anſwer the trouble, I laid the deſign aſide. Yet having now had by me for ſeveral years a table of the parabola, which ſhews the ſpace, and diſtance from the focus at all angles, and will, I think, by it's length, better anſwer the end of calculating a comet's place, than Dr. Halley's table can, I choſe no longer to conceal it: but that it might not ſeem too imperfect, by being publiſhed alone, I have added a ſhort account of the diſcoveries about comets, a catalogue of their orbits, the way I calculated the parabolick table,*

table, and method of uſing it, alſo how to conſtruct a comet's motion ſpeedily. In particular I have given ſome account of the uſe of Sir Iſaac Newton's famous problem for finding a comet's orbit from three obſervations, which till lately few perſons have ſtudy'd; yet ſeems to me a much better method, than that Caille has given in art. 518—560 *of his aſtronomy, which he ſhews in art.* 520, *does not anſwer in all caſes, and requiring ſo much correction by gueſs, muſt I think be very troubleſome. In ſtudying this problem of Sir Iſaac's I almoſt got beyond my depth; yet by comparing his explication with Dr. Gregory's, and the aſſiſtance at firſt of Mr. G. Whiſton, with a repeated examination ſince, I hope I have gained a tolerable knowledge of it, and have endeavoured to render the proceſs as exact, eaſy, and plain as I can. But though mathematicks is a ſcience capable of abſolute demonſtration, yet in ſo complex a problem, eſpecially where ſeveral parts are only approximations, the mind of man is frail, and may overlook ſome ſmall circumſtance, which may render his reaſoning a little defective: ſuch at leaſt I own my underſtanding to be, and the more as living in a retired place, I am forced to truſt to my own ſtrength. If therefore on tryal I be caught tripping, far from taking any friendly admonition amiſs, I ſhall think myſelf greatly obliged to any one more ſkilful than myſelf, who will by letter or otherwiſe inform me, either where I have miſtaken, might have made the method ſhorter or eaſier, or have omitted any further uſe or improvement; I ſhall not fail on any proper occaſion to acknowledge the favour, and, if opportunity offers, to make a due uſe of it, being deſirous to compleat the affair as far as I can.*

Lyndon, Rutland.
Sept. 15, 1756.

P. S. *Mr. Facio, as Dr. Halley mentions, thought of a uſe which may now and then be made of comets; by obſerving the parallax of one when very near the earth, to find the ſun's parallax, and conſequently it's diſtance, now known only to a fourth part. The expected comet will not come much nearer the earth than Mars does, if it's perihelion ſhould be in January or July; but would be within* 13 000 000 *of miles of the earth October* 19, *with a full minute's parallax, if it's perihelion is November* 27; *or have* $3'\frac{1}{2}$ *parallax May* 4, *at* 4 000 000 *of miles diſtance, if it's perihelion is March* 27.

OF

OF THE DISCOVERIES CONCERNING COMETS.

THOUGH the ancients knew little of the uſe of conick ſections, in compariſon of what has been diſcovered within theſe laſt hundred and fifty years, yet they applied them ſelves to the ſtudy of their properties, and thereby prepared the way for the readier applying them to the uſes lately found out. If thoſe who at that time employed themſelves in making aſtronomical obſervations, had been as careful in attending to the motion of comets, which do not require ſuch depth of thought as abſtruſe mathematical problems; though they knew too little then of the principles of motion to have found out their real path, yet probably we ſhould not have been ſo much at a loſs, as we ſtill are, as to their periods; but, by comparing their motions in different returns, even though the obſervations had been but groſs, might have arrived to a conſiderable perfection in the aſtronomy of comets. But as moſt of their periods ſeem to be very long, and it is but a little while that their motions have been carefully watched, it may be ſome ages yet, before we get any great knowledge about them. Moſt of the ancients, being of Ariſtotle's opinion, that comets were only inflamed vapours, raiſed, continuing, and diſperſed in our atmoſphere, took little further notice of them than as omens, often mentioning neither the time of year, or place they were ſeen in; and unleſs *both* are known, we can neither find their orbit, nor compare them with that of any known comet. Seneca indeed, and ſome others whom he mentions, believed comets to be *laſting heavenly bodies*, Nat. Quæſt. VII. 3 & 22. that *multitudes of them, which could not be ſeen on account of their poſition, kept on their ſtated courſe, and at certain times, when they got to the*

nearer end of their path, came within sight of men, Chap. 13, 17, 19. and he expected that *time and pains would discover what was then unknown, and posterity wonder that they did not know such plain things*, Chap. 25. In these several places there is a better guess about comets, than any made for above fifteen hundred years afterward: and further search has since confirmed what he thought, that it is the excentricity of their orbits which occasions their being only now and then seen. In all those dark ages, from the decline of the Roman empire to the Reformation, comets being only considered as ominous meteors, three only have been yet found described enough to determine their orbits, and those but in a gross manner: and I think Appian was the first, who, about 1530, began to observe their motion astronomically; and soon found that, so far from being within our air, they, having no sensible parallax, must needs be much further off than the moon: here then is the first step toward finding out the true nature of comets; and from that time all astronomers have allowed their place to be among the planetary orbits, and many observations were made of their motions by Tycho Brahe and others.

The two comets of 1664 and 65, coming within a few months of one another, made many persons very inquisitive about them; and in Birch's history of the Royal Society, Vol. II. there are two remarkable guesses, both read May 23, 1666. In page 93, are *Mr. Hooke's remarks on Monf. Petit's dissertation on the nature of comets, presented to the society some weeks before.* What that paper contained does not fully appear; but Mr. Hooke said, *the hypotheses were very ingenious, and some of them not improbable*, but whether the *comets were moved in equal spaces of a curve line in equal spaces of time, which Monf. Petit seemed inclined to believe, deserved to be further examined.* This last clause is remarkable, and that paper, if still preserved, is worth searching, to see how near Monf. Petit was to guessing the truth. The other paper, page 91, is Mr. Hooke's own, endeavouring to account for the planet's motions; where, having proposed the resistance of the æther, he says, *the second cause of inflecting a direct motion into a curve may be from an attractive property of the body placed in the center, whereby it continually endeavours to attract or draw it to itself: for if such a principle be supposed, all the phænomena of the planets seem possible to be explained, by the common principle of mechanick motions; and possibly the prosecuting this speculation may give us a true hypothesis of their motions.——By this hypothesis the phænomena of the comets as well as of the planets may be solved, and the motion of the secondary as well as of the primary planets: the motion also of the progression of the auges is very evident.* This I think was much about the time that Sir Isaac Newton discovered the property of gravity, and seems much like it; only Sir Isaac, being the deeper mathematician, prosecuted the matter further, and cleared it up more fully.

Hevelius was too good an astronomer, not to see that comets were far distant from the earth, and in his Cometographia, Book III. p. 149—164, largely

largely shews the absurdity not only of supposing them in our air, but even below the moon, from the vast parallax they would have, and the various places they must needs be seen in at different times of day, as they rise toward the zenith, or descend to the horizon: yet could he not shake off the established opinion that they were meteors; but, to reconcile both, supposes comets to be vapours collected near any of the planets, whirling round about it till thrown out of the atmosphere, and then moving in a straight or curve line till dispersed, Book VII. p. 384; that *comets are not spherical, but round and flat*, p. 338; and, from the time they leave the planet's atmosphere, *always turn one flat side toward the Sun*, p. 666; and though, Book IX. p. 591—632, he calculates the places of several comets, as if moving in a straight line, and generally comes nearer the observed place, than I should expect such an hypothesis to do; yet he thinks that *their course is not really straight*, p. 588; and in more largely treating on the subject, says, *it is a Parabola*, p. 659. It may surprize those who have not read Hevelius, to hear that he first said a comet's orbit is parabolical, a discovery generally attributed to Sir Isaac Newton; and indeed not without reason, for Hevelius did but guess it, and knew not the principle on which its motion depended, but it was Sir Isaac Newton who first proved it, and accounted for its motion in that curve, from that universal principle of Gravity, on which the motion of all the heavenly bodies depend. We may however give Hevelius his due praise as a good astronomer, and by a short extract from his Cometographia, Book IX. shew how nearly he guessed at the true motion of comets, without knowing, or even suspecting, the real cause which kept them in such a trajectory. A comet then, he says, "by no means moves in a straight line, but in a curve, always "concave toward the sun," p. 658, that is, "*in a Parabola*," p. 659: this he illustrates by "the parabolick motion of projectiles," p. 660. He seems here to be got very near the point, yet shews afterward he did not think of gravity as the cause of a comet's parabola: for "as projectiles "move in a parabola, from a compound of their progressive motion and "gravity, so comets also have a double motion; one the force given them "at leaving the planet's atmosphere, the other not gravity, yet something "not unlike it, by which comets turn one of their flat sides toward the "sun, as the center of our system, p. 666, as a magnetick needle points "toward the North, or toward a loadstone. And as in projectiles gravity, "so in comets the inclination of their flat sides, turns them out of their "straight course," as a rudder turns about a ship, which he had before largely considered, p. 570—587. "And the farther a comet gets from "the sun, the more will its flat side be opposed to its motion, which will "not only more and more retard its swiftness, but turn it out of its straight "course, p. 667. But a comet differs from a projectile, in that a body "thrown up moves slowest at the vertex of its parabola, and swifter both "in rising and falling; while a comet moves swiftest at the vertex, where

"a line

" a line from the sun is perpendicular to its path, and slower both in " approaching the sun and retiring from it, p. 669. If you ask whether " a comet's path is not an hyperbola," he " will not deny it: it is neither " circle nor ellipsis, but may be any other section of a cone, which is " most bent in the middle, and straighter at each end: yet is satisfied it " is rather a parabola than an hyperbola," p. 683. Lastly, " as the " planets regard the sun as their center, so the comets also obey it in their " way," p. 701. We see here that Hevelius, whether by a mere guess at what he thought must needs follow from his notion of comets being flat bodies, generally standing oblique to the path they move in, or finding such a motion to agree best with his observations, came very near to what has since been found to be the truth: that comets move in a parabola, concave toward the sun, swiftest at the vertex, that is, when they are nearest the sun, and their motion perpendicular to a line from it, and that it is an action of the sun on comets which makes them turn out of a straight line into a curved trajectory. So far he is right, and seems got near the point, but is defective in not suspecting the sun to be the parabola's focus, expresly denying their moving in an ellipsis, and consequently returning again; and the doctrine of gravity being a later discovery, he is forced to account for their curve another way. We may learn also from his book, that studies, of which we do not at first see the benefit, are not therefore always useless. Hevelius made many observations and calculations of the motion of comets; on which if a person at that time had said to him, *cui bono?* why so much time and pains spent on vapours, which were collected yesterday, and will be dispersed to-morrow? he, owning them to be nothing else, could not perhaps have given any sufficient reason for it: yet if he and others had not taken that pains, Sir Isaac Newton would hardly have found out their real motion; and there is a field yet open for further discoveries of future ages about them.

Sir Isaac Newton having discovered that gravity is universal, and that a planet whose velocity was in a due proportion to its gravity toward the sun, would revolve about it in a perfect circle; but in an ellipsis, of which the sun is one focus, if its motion was either faster or slower; on reconsidering the matter, on occasion of that remarkable comet of 1680, he found, that, if a body is thrown with a velocity, which is to that necessary to keep it in a circle, *as the square root of* 2 *to* 1; the same universal principle of gravity will make it move in a *parabola*, of which the sun is the focus: and this being found agreeable to the observed motion of comets, has been since allowed by astronomers to be their real motion. It seems however not agreeable to the uniformity of the universe, that after a short view of the sun, they should be continually flying farther off, in that wide void beyond the planetary bounds, to creep along that dark cold region for millions of years; (and in less time than that, they could not reach any other system, if the parallax of the fixed stars be two seconds, which Dr. Bradley

Dr. Bradley has found it cannot exceed;) but that they ſhould rather revolve round the ſun, in certain, though long periods: and the likeneſs of the elements of ſome of the comets ſeen in different ages, make it probable they were the ſame returning again; if ſo, their trajectories are not *really parabolas*; but they ſeem a kind of planets, revolving round the ſun in *ſo extreamly excentrick ellipſes*, that, ſo far as we can ſee them, they are not ſenſibly different from parabolas, which for eaſe of calculation we always ſuppoſe them to be: and that their motion is almoſt exactly a parabola, I intend to ſhew particularly as to the comet of 1744, ſee page 14. The true motion of comets being thus known, Sir Iſaac Newton applied himſelf to find a method, by which a comet's orbit might be determined from a courſe of obſervations; and, having attempted many ways in vain, hit at laſt on one, which he has explained, Boook III. Prop. 41, *&c.* of his *Principia*, taking for his example the comet of 1680. The ſame method Dr. Halley uſed for twenty-three more, ſome accurately, others groſsly, as the obſervations he met with were; and ſeveral more have been done ſince by others. From the likeneſs of the elements, ſome of theſe are ſuppoſed to be different returns of the ſame comet: firſt, thoſe of 1531, 1607, and 1682, with a period of 75 or 76 years, may be expected again about 1758: ſecondly, thoſe of 1532 and 1661, after a period of 128½ years, may probably return about 1789: thirdly, the obſervations of that in 1556 were very groſs, and thoſe in 1264 ſtill more defective, ſo that neither orbit can be ſuppoſed to be at all accurate; yet from their likeneſs, though not agreeing very well, may not unlikely be the ſame, and come again, after a period of 292 years, about 1848: laſtly, the comet of 1680 was a very remarkable one; and as at equal intervals, *A. C.* 44, *A. D.* 531, and 1106, others were ſeen in ſome reſpects like it, ſeveral perſons have ſuppoſed they might be the ſame, being 575 years going round the ſun; yet, no obſervations being made at any of the three former times, it was but a gueſs; and if the comet of 1106 was ſeen in March in Cancer, as the manuſcript Mr. Dunthorne mentions, Phil. Tranſ. XLVII. p. 287, ſeems to ſay, it could by no means be the ſame as that of 1680, which cannot get beyond Taurus in March, nor be ſeen in Cancer after December; the period therefore of that comet muſt remain doubtful, till further light appears.

It may be objected, that the two periods of the comet of 1682 being a whole year different one from the other, there is no knowing when to expect it again. The difference indeed is very great, conſidering how true the planet's motions are found to be; yet I fear we muſt not expect the ſame regularity in a comet's orbit as in a planet's, they being ſubject to many greater errors: firſt, croſſing all or moſt of the planet's paths, they may come nearer to one or other of them than any of the planets do to each other, and be more affected by their mutual attraction; eſpecially

if near Jupiter or Saturn, the greatneſs of which bodies, weaker power of the ſun, ſlowneſs of their motion, and conſequent long continuance near one another, and direction of the comet's path nearly toward the ſun, all join to make the alteration of its orbit more ſenſible: 2dly, a ſmall change of angle will make little difference in a planet's orbit, which is always nearly perpendicular to the ſun; but when a comet's path makes only five or ten degrees angle with a line from the ſun, a little variation will bear a greater proportion to that ſmall angle, than to 90 degrees: 3dly, as a comet's greateſt diſtance is many times its leaſt, if by a planet's attraction the perihelion is altered but a few miles, that may be greatly multiplied in the aphelion; and if the angle at firſt is changed but one minute, it may make a great alteration of length, in running four times as far as Saturn, and back again: 4thly, there is but little difference in the velocity of a body, going round the ſun in one or two hundred years, and of one keeping a perfect parabola; ſmall therefore muſt be the difference of one revolving in 75 or 76 years, eſpecially if the ſame power, which increaſes its velocity, ſhould make its perihelion diſtance greater. Now the comet of 1682, in its deſcent toward the ſun, may be near Mars, but that being ſmall will hardly affect it much; again, in going from the ſun, it may paſs near Venus, a little before it gets to the deſcending node, and near the earth a little after it: if then one or more of theſe planets ſhould be in that part of their orbit when the comet paſſes by, they may make ſome change in its motion. The comet of 1680 is very liable to alteration, as in its deſcent it may paſs not remote from any of the planets, extremely near the earth, and but a little way from Venus; its motion alſo being all the time almoſt directly toward the ſun, and its perihelion diſtance ſo very ſmall, a little change in its motion might make a very great one in its orbit.

The method Sir Iſaac Newton gives, in his *Principia*, is from three obſervations of a comet, at proper intervals, to find its real trajectory; and Book III. Prop. 41, he has explained in order the ſeveral proceſſes, deſigned chiefly for conſtruction, which was the way he uſed in his example of the comet of 1680. This operoſe problem Dr. David Gregory has more fully explained and demonſtrated, in the fifth book of his aſtronomy: it may alſo be reduced to triangles, and calculated by numbers, which is much more accurate than conſtruction by lines; and though conſiſting of about an hundred triangles, Dr. Halley undertook it for 24 comets, as others have ſince for 20 more; and ſome of them, by greater care or nicer obſervations, to a very great degree of exactneſs. Yet as a compleat liſt of the triangles uſed, and ſeveral cautions neceſſary in practice, are not publiſhed, I have choſen to ſet them down here, not generally repeating the demonſtrations, which Sir Iſaac Newton and Dr. Gregory have already done, but ſuppoſing one of thoſe books at hand, to add ſome obſervations for preventing miſtakes, and ſhewing how it may be reduced to triangles: the letters here uſed are the ſame as in Sir Iſaac Newton,

except

except ſome few which he had not, and are generally thoſe which Dr. Gregory uſes.

He then who would calculate a comet's orbit by triangles, ſhould firſt conſtruct it as true as may be by lines; for as the method is approximation, it is to no purpoſe to calculate nicely, while the point tried is much wrong, as the firſt gueſs will moſt likely be; and as the accuracy depends on having, in fig. 2. B near μ, (ſee Greg. V. 18, 19.) he cannot at firſt chuſe ſuch obſervations as will make it ſo. Firſt therefore, out of a ſet of obſervations on a comet, chuſe three ſo that you gueſs that interval of time when the comet was neareſt the ſun is the ſhorteſt, but no great nicety is required this firſt time. On a large ſheet of paſteboard, draw a circle ten inches radius for the *magnus orbis*; mark the points the earth was in at the three times of obſervation, and call them T, t, and τ, (ſee fig. 1); from theſe draw the three obſerved longitudes of the comet, T A, t B, and τ C: on t B take any point B, let V be the interſection of St and Tτ, and γ the place the comet was in perpendicularly over B; make $S\gamma^3 : SB \times R^2 :: tV : BE$, which ſet off on the line S B: through E (Newton's *Princip.* III. lemma 7.) draw A C cutting T A and τ C, ſo that $AE:EC$ as the time between the firſt and ſecond obſervations, to the time between the ſecond and third. A and C are near enough for the firſt trial, the curtate places of the comet in its orbit. To try how true they are, let T A be to the perpendicular A M, as radius to the tangent of the comet's apparent latitude the firſt time, and $\tau C : CN :: R$: tang. of apparent latitude the laſt time, and draw MN the chord of the parabolick arc $M\gamma N$, along which the comet moved, while the projection of the points on the ecliptick are A, B, C: then ſay $SB : S\gamma :: SB + \frac{2}{3}BE$ to a fourth number, nearly equal to (SR, ſee Greg. V. 20.) the diſtance from the ſun at which a comet would move the chord M N, in the ſame time as it really did go the arc $M\gamma N$: let X be the length run by a comet at the earth's mean diſtance from the ſun, in the time between the firſt and third obſervations (Newt. *Prin.* III. 40.) then $\sqrt{SR} : \sqrt{\text{radius}} :: X : MP$, being the length a comet would go in the ſame time at the height S R. If M N be equal to MP, the point B was taken right; but if very different, as may eaſily be this firſt time, take a new point b, find $a\,c$, and try till M N is nearly equal to M P. Being now near the matter, we muſt be more exact: biſect the trueſt A C in I, (ſee fig. 2.) erect a perpendicular $Ii = Bb$, draw Si, and erect $\lambda\mu$: if μ falls on or near B, the obſervations are rightly choſen; if not, take one or more new obſervations, to make B as near as poſſible to μ, and rather between i and μ than otherwiſe, (Greg. V. 18, 19.)

The circle drawn for the *magnus orbis* will do again, as will T, t and τ, if carefully drawn as to angle and diſtance, and the ſame obſervations are ſtill uſed; as alſo the three longitudes T A, t B, and τ C. Set off t B as near as now known, draw A C as before, biſect it in I, erect the perpendicular $Ii = Bb$, (ſee fig. 2.) compleat the rectangle $I i \lambda \mu$, and μ is nearly the vertex of the parabolick arc A B C; (Greg. V. 19. coroll.) but may be further

further corrected thus. Produce Iμ to η, so that $\mu\eta = \frac{1}{2}\mathrm{I}\mu$; through S draw $\eta\xi = 3\,\mathrm{S}\eta$, in the line B$\xi$ take a new point E′, and if the former length BE is not true enough, which yet it will generally be for construction, a truer length for BE′ may be found, as directed presently for calculation, thus: a sidereal year is to the time between the first and third observations, as the circumference of a circle to the length of the mean arc the earth moves in that time; the square of half that arc divided by twice the radius, is the fall of the earth in half the time: this, if now done accurately, need not be repeated in N°. 7 of the calculation: then $\mathrm{SB} : \mathrm{S}\gamma :: \mathrm{SB} + \frac{1}{3}\mathrm{I}\mu : \mathrm{SL}$ and $\mathrm{SL}^3 : \mathrm{R}^2 \times \overline{\mathrm{SB} + \frac{1}{3}\mathrm{I}\mu} ::$ the fall of the earth : BE the fall of the comet. Through E′ draw A′C′, and form the rectangle I′$i'\lambda'\mu'$, μ' is the vertex of the parabolick arc, (Greg. V. 19. coroll.) and Bξ divides the chord very nearly in proportion to the times (V. 18). It remains then to try whether the point B was guessed right: say then $\mathrm{SB} : \mathrm{S}\gamma :: \mathrm{S}\mu' + \frac{2}{3}\mathrm{I}'\mu' : \mathrm{SR}$, and as above find MN and MP: if they are not equal, draw GP parallel to C′N, then is C′G the error; take a new length *tb*, and repeat the process to find a new *mn* and *mp*, and error *c′g*. The two figures 3, which are the small part YCG of fig. 1 and 2, shew the two cases of this correction, when C and *c* are on the same or opposite sides of *z*; where a line drawn through G and *g* the two points of error will cut YC, that is in the point the comet was really over, when, by a wrong guess at the length *t*B and *tb*, it came out C and *c*; and setting off A′F and *a′f* equal to C′G and *c′g*, the true point *x* may be in like manner found. We may now either proceed to calculate the orbit arithmetically, from the length of *t*B now very nearly known, or find the elements of the orbit by construction thus; (see fig. 4.) two points of a parabola *m* and *n*, perpendicularly over the curtate places *x* and *z*, with the focus the sun, determine the whole curve: draw then *xz*, and erect two perpendiculars *xm* and *zn*, the tangents of the comet's latitude at the first and third observations, T*x* and τz being the radii; S☊ drawn through the sun and the intersection of *xz* and *mn*, is the position of the comet's node. $z\varrho$ a perpendicular let fall from *z* on S☊, is to *zn* the tangent of its latitude, as radius, to tangent of the inclination of the orbit. Produce the perpendiculars $x\sigma$ and $z\varrho$ to *m* and *n*, as cosine of inclination to radius, which will be in that position to each other, the sun and line of nodes, as the comet was in its orbit at the first and third observations; on *m* and *n* (fig. 5.) with radius S*m* and S*n* draw two circles; a tangent to both circles may be drawn by the eye, or thus, bisect *mn*, draw a circle on that center passing through *m* and *n*, and set off $m\iota = n\gamma = \mathrm{S}n - \mathrm{S}m$, which produce to δ and $\varkappa$; $\pi\varkappa\delta$ being parallel to $m\gamma$, which is perpendicular to both radii $m\varkappa$ and $n\delta$, touches both circles, and Sπ a perpendicular on it from S, is double the perihelion distance: (De la Hire's plain conicks.) Wherefore P, the bisection of Sπ, is the vertex of the parabola or perihelion point, whose position is determined by the angle *n*SP or *m*SP; as is the time the comet was there, because the parabolick space *n*S*m*, is to the

the parabolick space *m* S P, as the time between the observations, to the time between the perihelion and first observation.

Thus are the elements of a comet's orbit found by construction; but if exactness is required, lines will not do it, but the process must be reduced to triangles, and calculated by numbers. And first see that the observations are good, or else be content with construction, for it is to little purpose to calculate nicely by uncertain data. Next try whether the times are rightly chosen, by the directions already given, (see page 7.) and, for further accuracy, be not content with the earth's places as found by the tables of the sun, but correct them by the menstrual parallax. The weight of the earth being to that of the moon as 39.788 to 1, the distance of the moon, is to the distance of the common center of gravity, as 40.788 to 1. (Newt. *Princ.* III. 37. cor. 4 and 6.) In fig. 6. E is the earth, and M the moon, revolving round C their common center of gravity which moves regularly along the *magnus orbis* A C B round the sun S; then at any time the sine of the moon's horizontal parallax, is to the sine of the sun's parallax divided by 40.788, as S C to C E. In the triangle S C E, given S C, C E and S C E, then C S E is the required correction of the sun's place, and S E the real distance of the earth from the sun. This triangle however need not be solved, the tables IV. and V. giving the required correction in angle, and the length of the line E D, to be added to or substracted from S C, the distance of the sun as found by the common tables. As the moon has sometimes above five degrees of latitude, and therefore the earth is not absolutely in the plain of the ecliptick, for perfect exactness that should be allowed for; but as the whole menstrual parallax is very small, this, which is but a small part of it, may I suppose be safely neglected. Lastly, before calculating, draw a set of figures suited to the particular case, for no general rule can be given where to add and where substract; the case I have drawn, and suited the *plus* and *minus* to, is the comet of 1742; and another set of figures will shew, whether to add or substract in that case. Thus prepared, the following is a list of the triangles required, what is given and what is sought, for fixing the due length of the lines, which determine the comet's trajectory.

N°.	Triang.	Given.	Sought.	Remarks.
1	S T τ	S T, S τ, and T S τ	S T τ, S τ T, [and T τ	S T τ — S T Y = τ T Y. [S τ T — S τ Y = T τ Y
2	T Y τ	T τ and τ T Y (N°. 1) and T Y τ	T Y and τ Y	See fig. 1.
3	S *t* B	*t* B (a guess) S *t* and S *t* B	*t* S B and S B	*t* S τ + *t* S B = D S τ
4	*t* B γ	γ perpendicularly over B	R : tang. ap. [Lat. :: *t* B : B γ	
5	S B γ	S B (N°. 3) B γ (N°. 4) S B γ = (90°)	S γ	[Construction
6		S B : S γ :: S B + ¼ I μ	: S L	I μ taken from the last
7		365.256 ; U + W :: 2 R × 3.14159	: $\chi \dotplus \omega$	$\frac{\frac{1}{2}\overline{\chi \dotplus \omega}^2}{2R} = \zeta \dotplus$. Greg. I. 25. [cor. 1.

No.	Trian.	Given.	Sought.	Remarks.
8		$SL^3 : R^2 \times \overline{SB + \frac{1}{8} I\mu} :: \zeta \downarrow$	: B E	
9	D S τ	S τ, S τ D and D S τ (N°. 3)	S D and τ D	SD + BE − SB = DE
10		W : U + W : : D E	: D Q	A H equal and parallel to [D Q
11	A H Y	A H (N°. 10) A Y H and A H Y (N°. 9)	AY and HY	τD + HY − τY = HD
12		U : U + W : : H D	: H C	
13	A C H	A H, H C and A H C	ACH, CAH, [and AC	AYC + ACH + YAC [= 180°
14		U + W : U : : A C	: A E	
15	B E *b*	BE (N°. 8) B*b*E (= 90°) BE*b* (= SDτ − ACH)	B *b* = I *i*	See fig. 2.
16	S E I	SE (= SB − BE) IE (= $\frac{1}{2}$AC − AE) SEI (N°. 15)	S I E and S I	SIE + 90° = SI*i*
17	S I *i*	S I, I *i* (N°. 15) and S I *i*	S *i* I	
18	I *i* λ	I *i*, I *i* λ (N°. 17) *i* I λ (= 90°)	*i* λ = I μ	I μ × 1.5 = I *n*
19	S I μ	SI (N°. 16) I μ and S I μ (= SIE + Iλ*i*)	S μ	
20	S I *n*	SI, I*n* (N°. 18) and SI*n*	*n* S I and S *n*	2S*n* = Sξ.*n*SI − ISE = *n*SE [the Suppl. of BSξ
21	S B ξ	S B, S ξ and B S ξ	S B ξ	Greg. V. 18.
22	B D D	BDD′ (N°. 9) DBD′ (= SBξ) BD (= SD − SB)	BD′ and DD′	
23		$SB : \underline{S\gamma :: S\mu + \frac{1}{3} I\mu}$	: S L	Greg. V. 21.
24		$SL^3 : R^2 \times \overline{S\mu + \frac{1}{8} I\mu} :: \zeta \downarrow$	: B E′	B D′ + B E′ = D′ E′
25	S E′ B	S B, B E′ and S B E′ (N°. 21)	SE′ and BSE′	

Repeat 10 — 19 to find A′C′, SI′, I′μ′ and Sμ′

No.	Trian.	Given.	Sought.	Remarks.
(11) 27		A′ H′ Y = B D′ D (N°. 22)		τD + H′Y − τY − DD′ [= H′ D′
(15) 31		B E′ *b*′ (N°. 22 and 29)		
(16) 32		SE′ (N°. 25) S E′ I′ = Suppl. B E′ *b*′	+ SBξ + BSE′	
36		$S\mu' : S\mu' + \frac{1}{8} I'\mu'$	: S ρ ÷	
37		S B : S γ : : S ρ	: S R	
38	T A′ M	R : tang. Lat. : : T A′	: A′ M	
39	τ C′ N	R : tang. Lat. : : τ C′	: C′ N	
40	M K N	MK (= A′C′) KN (= C′N − A′M) MKN (90°)	M N	
41		$\sqrt{SR}$ (N°. 37) : $\sqrt{R}$: : $\chi \downarrow \omega$ (N°. 7)	: M P	Greg. I. 42. and V. 20.

If M N = M P, M and N are two true Points in the comet's orbit, proceed therefore to N°. 89; and thence find the elements; but if not equal, take a new point *b*, so that

$$\left.\begin{matrix} MN : MP \\ \sqrt{S\gamma'} : \sqrt{S\gamma} \end{matrix}\right\} :: Ye : Ye',$$

and repeat the whole process, except N°. 1, 2, and 7.

No.	Trian.	Given.	Sought.	Remarks.
80		M N : N P : : A′ C′	: C′G = A′F	
81		*mn* : *np* : : *a*′ *c*′	: *c*′*g* = *a*′ *f*	See fig. 3.
82	*c*′ *p g*	*c*′*g*, *cpg* (= A′C′H′ N°. 29) *pc*′*g* (N°. 67)	*c*′*p* and *p g*	YC′ − Y*c*′ ∓ *c*′*p* = C′*p*
83		C′G ± *pg* : C′*p* : : C′*g*	: C′ *z*	τC′ − C′*z* = τ*z*
84, 85	}	In like manner find A′ *x*		T A′ − A′*x* = T *x*
86	T *x m*	R : tang. Lat. : : T *x*	: *x m*	
87	τ *z n*	R : tang. Lat. : : τ *z*	: *z n*	
88	*x* Y *z*	Y *x* (= T *x* − T Y) Y *z* and *x* Y *z*	Y *z x* and *x z*	
89	S T *x*	S T, T *x* and S T *x*	T S *x* and S *x*	
90	S τ *z*	S τ, τ *z* and S τ *z*	τ *z* S and S *z*	τ *z* S − Y *z x* = S *z x*
91		(*z n* − *x m* =) *r n* : *r m* : : *z n*	: *z* ☊	See fig. 4.
92	S *z* ☊	S *z* (N°. 90) *z* ☊ and S *z* ☊ (N°. 90)	*z*S☊ and S☊	τ S *z* − *z* S ☊ = τ S ☊. [Place of the Node.
93	S *z* ϱ	S *z*, *z* S ϱ and S ϱ *z* (= 90°)	*z* ϱ	
94	*n z* ϱ	*z* ϱ, *z n* and *n z* ϱ (= 90°) *z* ϱ : *z n* : : R	: tang. *z* ϱ *n*	Inclination of the Orbit.
95	S *x m*	S *x*, *x m* and S *x m* (= 90°)	S *m*	
96	S *z n*	S *z*, *z n* and S *z n* (= 90°)	S *n*	
97	*r m n*	*r m* (N°. 88) *r n* (N°. 91) *m r n* (= 90°)	*m n*	
98	S *m n*	S *m*, S *n* and *m n*	S*nm* and *m*S*n*	See fig. 5.
99	*m n* γ	*m n*, *n* γ (= S *n* − S *m*) *m* γ *n* (= 90°)	*m n* γ	180° − S*nm* − *mn*γ = *n*SP

N°.	Triang.	Given.	Sought.	Remarks.
100	S *n* ☊	S *n*, S ☊ (N°. 92) S *n* ☊	*n* S ☊	*n*SP — *n*S☊ = PS☊. Perihelion from [Node.
101	S *n* θ	S *n*, *n* S θ, and S θ *n* (= 90°)	S θ	$\frac{\theta\pi + S\theta}{2}$ = SP. Perihelion Distance.
102		Parabolick space PS*n* — PS*m*, is to PS*m*, as time between the observations, to time between the Perihelion and first observation		Time of Perihelion.

N. B. The parabolick space may be either taken out of the table of the parabola, or calculated in the same manner that was done.

N°. 7. I call the time between the first and second observations U, and that between the second and third W. Then a sidereal year is to the whole time, as the circumference of the circle to the arc moved in that time: and the square of half that arc, divided by twice the radius, is the earth's fall toward the sun in half the time.

N°. 6, 7, 8. I find BE this way rather than Sir Isaac Newton's, which is only an approximation, and irregularly too great or too small, as the times are more or less unequally divided, and T *t* τ in the more or less curved parts of the earth's orbit. But this way, if found as in N°. 23, 24, would be true; and Sμ being not yet known, I use SB for it, which is very nearly the same: nor is Iμ yet found, but as the comet has been already constructed, it is there given near enough for this process.

N°. 20. Since, by Greg. V. 18, the right line $n S \xi = 3 S n$ is the truth, full as easy, and, requiring no taking out natural numbers, is less liable to error, I wonder Sir Isaac chose to approximate it by the point σ, and $\sigma\xi = 3 S\sigma + 3 i\lambda$. (See his fig. Book III. Prop. 41.)

N°. 23, 24. In Greg. V. 21, the comet's fall at the height SL is MV = VZ, (see his fig.) Now B and μ nearly coinciding, by similar triangles $SB : S\gamma$ (N°. 5) :: Sl ($= S\mu + \frac{1}{3} I\mu$) : SL. Again, $SL^2 : R^2 :: \zeta\psi$ (the earth's mean fall) : the fall at the point L. Greg. I. 42. And by similar triangles $SL : S\mu + \frac{1}{3} I\mu$ :: the fall at L : BE; then $SL^3 : R^2 \times \overline{S\mu + \frac{1}{3} I\mu} :: \zeta\psi : BE$. This is the true length of μZ or BE, and seldom sensibly different from BE′, which yet being more perpendicular to AC, is a little shorter; and if BE is so long and so oblique to AC, that the very small angle EBE′ will sensibly alter its length, then the sine of BE′*b* : sine of BE*b* :: BE : BE′ may be something truer.

N°. 36. The third proportional to Sμ and $S\mu + \frac{1}{3} I\mu$, which is the truth, see Greg. V. 20, is easier found in Logarithms than $S\mu + \frac{2}{3} I\mu$.

N°. 37. It is here fit to shew cause for this considerable variation from Sir Isaac Newton. Greg. V. 20, shews that a body at the height SR (see his fig.) would move the chord AB, while the comet really moved the arc AVB. Now μ, *l* and ϱ, in fig. 2, are the projection on the plain of the ecliptick of his V, L and R: then SR, the hypothenuse of the right-angled triangle SϱR, is Gregory's line SR, and therefore the length sought. Sir Isaac's $ID = S\mu + \frac{2}{3} i\lambda$ is nearly the same as Sϱ; but his IO, being the comet's

comet's mean height above the ecliptick, may if the time is unequally divided, and the inclination of the comet great, considerably differ from the height sought at Sϱ, which is in Sμ produced: therefore, as in N°. 23, SB : Sγ : : Sϱ : SR, by similar triangles.

N°. 38, 39. M and N being the points the comet was really in, perpendicularly over A′ and C′, T A′, the curtate distance, is to A′ M the height, as radius to tang. of the apparent latitude at the first observation. The like of C′ N.

N°. 41. The reason of this double proportion is this: M N, and of course A′ C′ and the perpendicular Y e, is too large in the proportion of M N to M P; but M P will increase or diminish, as $\sqrt{S\gamma'}$ is less or greater than $\sqrt{S\gamma}$. Greg. I. 27. This however is very hard to find, and only an approximation at last. An easier and as good a way is, to compare the error of the last construction with the error now found by calculation: thus N P — N P the difference of the errors, is to t B — t B the difference of the guesses, as N P the present error, to the required correction of t B.

N°. 80, 81. Sir Isaac Newton takes C G = N P; but as the correction is in the plain of A C, not of M N, I make G the projection of P, as C is of N. And if C G is not parallel to cg (fig. 3.) or C c bears not the same proportion to τ C, as A a to T A, it may make some difference in the places of x and z, though seldom much.

N°. 80, 81, 82, 84, are not wanted if A C is parallel to ac; for then 83 and 85 will be, $NP \pm np : NP :: Aa : Ax :: Cc : Cz$.

Sir Isaac Newton in his next proposition, and Dr. Gregory V. 31, shew how, by the rule of false, to correct still further the comet's orbit as above found: but that I have here omitted, as hoping and expecting that the directions I have given, being contrived to avoid all error as much as possible, will give the orbit true enough without that laborious correction, which I can hardly think is much less trouble than the calculation of the orbit itself. The changing the comet's *parabolick orbit* into its real *elliptical one*, by this correction, thereby to discover its period, can I doubt be at best but imperfectly done, from the small part of the orbit we can see, especially if so true a parabola as the comet of 1744 had: and unless we see a comet for a very long time, we must be content to wait for that more certain, though tedious discovery, the returning after another period. If any one however, desirous of the utmost exactness, chuses to undertake this last correction, Sir Isaac Newton and Dr. Gregory have both explained and shewn the use of it.

As several persons, especially of late years, have apply'd themselves to finding by Sir Isaac Newton's method, the orbits of several comets, but the result of their labours is no-where that I know of, collected into one view, I have here made a general table of all that I have found. And as since 1700 many are calculated by two persons, I set down both orbits, not always knowing which is best, and thinking it useful to preserve all,

to

to be at leisure compared, either by observations already made, or by those who shall see their next returns. Some of these different orbits vary little, as that of 1744, others differ widely, as that of 1739; probably sometimes from defectiveness in the observations one or both of the calculators used. I found several difficulties in making this table, from false prints, and authors not being always careful to set down the *ascending node*, having more than once found two persons set down the same comet's node in the opposite signs. By comparing the orbits with the observations, I have aimed to avoid mistakes, but have not met with observations of all of them to compare with, and lesser errors may escape; if therefore the authors, or any one else, shall find any mistake inadvertently slipped in, I shall be obliged to them for an account of it, and not fail to correct it when opportunity offers. See the list in table I.

The first 7 of these comets, and those of 1593 and 1596, being but imperfectly observed, can be but grossly done; as also those of 1678 and 1702, unless the calculators used better observations than I have found: that of 1533 will by no means suit the observations in Hevelius, so that I suspect some mistake or false print: Struijck gives the comet of 1699 from Caille, but makes the perihelion Jan. 2, and the ascending node in ♒, which is right I do not know, any further than that I have found Caille carelessly setting down the wrong node in other instances: not having met with the observations, I can say nothing of the accuracy of those of 1699, 1706, 7, 29, 43, and 48: Downes's orbit of the comet of 1718 suits best, so far as I have tried it, and Caille's of 1739: none of the orbits of the comet of Jan. 1742 agree well with the set of observations in Phil. Trans. No. 481; mine, which was calculated from the observations there mentioned of Mar. 2 and 16, and Apr. 2, agrees I think as well as any of them, but generally gives the latitude too small, being done a good while ago, from a more imperfect list of triangles than that here given in pages 9, 10, 11: C and Struijck differ 10 degrees in the node of the comet of December 1742, which is probably a false print, but I cannot correct it: the comet of 1747 was seen in August 1746, half a year before its perihelion, being then between two and three times as far from the earth as the sun is, and between three and four times the earth's distance off the sun; and its perihelion being above twice the earth's distance, we must not expect exactness there: Dr. Bradley's two comets of 1723 and 1737 are very accurate; as is also Betts's of 1744, calculated from observations made between Dec. 23, 1743, and Feb. 18, 1743-4; but as it was seen for a little while about two months before, when far distant from the earth, and much more from the sun, I have compared three observations sent me from Mr. Morris with Betts's orbit, and found them to agree perfectly; which proves both the truth of the elements, and that the comet's ellipsis was so far at least insensibly different from a parabola; or else those observations, made four months before the perihelion, and two before the obser-

 vations

vations the orbit was found by, would not have agreed ſo well: the hour of obſervation not being given, I have in the following table calculated for $8^h\ 17'$ each evening.

Comet of 1744, *ſeen in* 1743.								
	Obſervation.				Calculation.			
	Long.		Lat.		Long.		Lat.	
	° ′		° ′		° ′		° ′	
Oct. 22	♉ 26 . 46	N.	7 . 35		♉ 26 . 41	N.	7 . 35	
27	24 . 14		8 . 28		24 . 15		8 . 31	
Nov. 1	21 . 25		9 . 26		21 . 25		9 . 28	

I collected theſe orbits from firſt, Dr. Halley's 24 comets, now printed in his aſtronomical tables; ſecondly, Caille's liſt in his aſtronomy, art. 560, Robertſon's tranſlation, page 236; thirdly, a collection by N. Struijck, Phil. Tranſ. N°. 492; fourthly, ſeveral ſingle ones, 1723, 37, 39, 44, and 1264, from Phil. Tranſ. N°. 382, 446, 461, 474, and Vol. 47, page 283, and Mr. G. Whiſton's of 1718, from himſelf. The reaſon of my adding and altering ſome particulars in this table are theſe: the articles uſed in calculating a comet's place are, the time of the perihelion, log. of diurnal motion, diſtance of perihelion from node, coſine and ſine of the comet's inclination, place of the node, whether direct or retrograde, and log. of the perihelion diſtance; theſe therefore are all inſerted: and ſince, notwithſtanding care, falſe prints will ſometimes creep in, and I have met with difficulties from them, I aim to frame this table ſo as to find them out. The obſervations will ſoon ſhew whether the year of the comet is right; but on the ſecond column I neither have, nor know how to find any check: the log. of the diurnal motion is found from the log. of the perihelion diſtance, if therefore theſe articles agree together, both are probably right, if they do not, the natural perihelion diſtance will ſhew which is true: the perihelion place is a fictitious thing, for its diſtance from the node is meaſured in the plain of the comet's orbit; but that, eſpecially in a very oblique comet, is by no means the ſame number of degrees on the eclip-tick, except at the nodes and their perpendiculars; the only uſe therefore of inſerting it is, by comparing that, the node, and perih. poſt nod. together, to find out any falſe print: as to the ſeventh column, Dr. Halley gave the diſtance of the perihelion from the node, whether before or after; but I count the number of degrees a comet moves, from paſſing its aſcending node to its perihelion, whether more or leſs than 180 degrees; this ſaves a little trouble in computing a comet's place, as I ſhall ſhew when I come to explain that, (ſee page 18). The node, being the connexion of the plain of the ecliptick with the comet's orbit, is the key of the whole work; and whoever calculates or collects orbits, ſhould remember, that it is the *aſcend-*

ing

ing node must be inserted, and the article perih. post nod. reckoned from that, or else confusion is caused, and the comet found in false latitude: giving the inclination of the orbit is not strictly necessary, if its sine and cosine are but given, which prove one another: the twelfth column needs no explaining: and in the last I give the calculator's name, where I know it; but as Caille names no author, those taken only from him are marked C, as I can trace them no further.

Dr. Halley made a table of the parabola, for finding a comet's place at any time, printed with his list of orbits, and shewed the way of using it: he goes the direct way, for, dividing the first quadrant of the parabola into 100 equal parts, he gives the angle each is in from the vertex, and its increase of distance from the focus: but the calculation being tedious, and one such part altering the angle but little, at a distance from the vertex, he computed every part only to 100, that is, to the *latus rectum*, and to every second, fourth part, or greater interval afterwards. This table is 240 lines in all, but though very useful has some defects; for, being too short, the differences are often too large, and too unequal, for finding proportional parts truly, especially in the log. of the distance; again, proportional parts can hardly be found at the breaks, where the interval alters from 1 to 2, 4, 10, 20, 500, 40000, and 50000; lastly, it may however serve as far as 1000, that is, $144°\frac{1}{2}$ from the perihelion, which is far enough for many comets, but those whose perihelion distance is small, are seen much further; that of 1680 goes near $162°\frac{3}{4}$ within four days after its perihelion, and may be seen to about 174°, this table therefore will by no means do for that. Finding these inconveniences, and not caring for so difficult a calculation as Dr. Halley's, I thought of interlining his table by the differences, but found it very troublesome; and being advised to make a new table, on an easier plan, to find the distance and space from the angle, I considered it, and found the demonstration plain, the calculation very easy, the method such as might be carried on regularly, from beginning to end of the table, and having finished it, the differences were more regular than I expected; for proportional parts will determine to about half a second, the angle the comet of 1680 is in from the sun, at the greatest distance we can see it, and the log. of distance almost to perfect exactness, in any part of the table. The principles of this method may be seen in fig. 7. and let R stand for radius, s for sine, and v for versine.

(1) $\begin{cases} SC = ST = SR \\ Sc = St = Sr \end{cases}$ De la Hire's plain conicks. Parabola, Prop. 4, cor.

(2) $\begin{cases} PQ = PT = SC - SP = \varrho - 1 \\ Pq = Pt = Sc - SP = \varrho - 1 \end{cases}$ Prop. 7.

(3) $RQ = rq = 2SP$ Prop. 9.

(4) $SmnP = \frac{2}{3}\overline{Sm \times SP} = 1.\dot{3} \because 1 = \frac{3}{4} SmnP$

(5) $\begin{cases} RQ : SC :: v. \text{ of } RSC : R \\ rq : Sc :: v. \text{ of } rSc : R \end{cases} :: 2 : \varrho = \frac{2}{v}$ (See 1. and 3.)

(6) $R : s :: \varrho : \sigma = \varrho s$

(7) $\left\{ \begin{array}{l} SCmP = \frac{1}{2}\overline{SP + \frac{1}{6}PQ} \times \sigma \\ ScnP = \frac{1}{2}\overline{SP + \frac{1}{6}Pq} \times \sigma \end{array} \right.$ Quadrature of parabola.

(8) $\left\{ \begin{array}{l} \frac{3}{4}SCmP = \frac{3SP + PQ}{8} \times \sigma = \frac{3 + \varrho - 1}{8} \times \sigma = \frac{2 + \varrho}{8} \times \sigma \\ \frac{3}{4}ScnP = \frac{3SP + Pq}{8} \times \sigma = \frac{3 + \varrho - 1}{8} \times \sigma = \frac{2 + \varrho}{8} \times \sigma \end{array} \right.$

ϱ may be found a little eaſier thus, by fig. 8.

(9) $SB^2 = AB \times VB = 2Rv$ by ſimilar triangles.

(10) $SM^2 = \frac{Rv}{2} = s^2$ of $\frac{1}{2}SCB$

(11) $\frac{R}{SM^2} = \frac{2R}{Rv} = \frac{2}{v} = \varrho$ as before found.

Examples of the firſt method.

Angle from aphelion	112°.55′		65°.50′	
2	0.3010300		0.3010300	
v	0.1428248		9.7712991	
σ { ϱ	0.1582052 =	1.4394	0.5297309 =	3.3863
σ { s	9.9642937	2.	9.9601655	2.
$2 + \varrho$	0.5364926	237	0.7312940	55
Ar. Comp. 8.	9.0969100	126	9.0969100	81
$ScnP$	9.7559015	302	0.3181004	129
		99		34

Examples of the latter method.

Angle rSc	122°.45′		Angle RSC 61°.10′	
	1.2978		3.8629	
$\frac{R}{SM^2}$	0.1132346		0.5869212	
$s.$	9.9248161	268	9.9425171	77
$2 + \varrho$	0.5182349	132	0.7681176	74
Ar. Comp. 8.	9.0969100		9.0969100	
		334		112
$ScnP$	9.6531956	106	0.3944659	51

This method of calculation, by which the parabolick table, N°. II. is made to every fifth minute of angle, ſuppoſes, as is the natural and regular way, that the parabolick ſpace at 90 degrees from the vertex is 1, and ſo I ſhould have entered it in the table, had I been to chooſe; but Dr. Halley having divided that ſpace into 100 parts, and fitted the log. of diurnal motion and method of reckoning to that, I have, to avoid confuſion, ſuited my

my table to his, by adding two to the index of the ſpace as above found. The log. of diſtance proceeds regularly all the way, with increaſing differences; but one break was neceſſary in the mean motion, for the log. of ſpace is extreamly unequal near the perihelion, as is the natural ſpace at a great diſtance from it; the firſt 45 degrees therefore is the natural ſpace, and the reſt of the table its logarithm: yet no difficulty can hence ariſe, ſince both are very regular where the table alters. As the differences increaſe very faſt toward the end of the table, No. III. ſhews how near proportional parts will give a comet's real angle and diſtance: 45 degrees from the perihelion is tried, becauſe there the differences of the log. of mean motion decreaſe, while thoſe of the log. of diſtance increaſe, yet no ſenſible error does thence ariſe: few comets are ſeen above 155 degrees, nor that of 1680 more than about 174 degrees from the perihelion. The two firſt columns are the angle, and true log. of mean motion; the third is the angle which proportional parts would give as anſwering to that logarithm: for inſtance, 7.522283 is the true log. of mean motion for $178^\circ.57'.30''$, but proportional parts would give $178^\circ.57'.27''$ for it, that is $3''$ wrong; and 7.523327, the arithmetical mean between the mean motion at $178^\circ.55'$ and 179°, would be called the log. of mean motion for $178^\circ.57'.30''$. The fourth column is the true logarithm of diſtance; and the fifth what logarithm of diſtance proportional parts would give, as anſwering to the true log. of mean motion: and though the differences increaſe ſo greatly toward the end of the table, yet as both log. of mean motion and log. of diſtance increaſe proportionally, no error is thereby cauſed; and this is the caſe uſed in calculating a comet's place: but if on any other occaſion, the log. of diſtance at any certain angle is required, the ſixth column gives the log. of diſtance found by equal diviſions, the ſeventh its error, and the eighth how much that point of the parabola is by this error carried too far from the focus: for inſtance, 2.115806 is the true log. of diſtance at $169^\circ.57'\frac{1}{2}$, by equal diviſions 2.115813 will be found for it, which is 7 too much, and that point is by this means made $\frac{1}{300000}$th part too far diſtant from the focus; this is the greateſt error between $169^\circ.55'$ and 170°, for if tried at $169^\circ.56'$, $57'$, $58'$, or $59'$, the error is leſs. We ſee then that in the caſe of computing a comet's place, this table will never err more than half a ſecond in angle, (much nicer than any orbit is known,) and in all places gives the log. of diſtance true.

Since the velocity of a body moving in a parabola, is to that of one moving in a circle, as $\surd 2$ to 1, (Newton's *Princ.* I. 16, cor. 7.) the periodical time of a planet, is to the time a comet of equal perihelion diſtance takes to go its firſt quadrant, as the area of the circle $= 1 \times 3.14159$, to the area of that quadrant divided by the $\surd 2$, that is, $\frac{1 \times \frac{4}{3}}{\surd 2} = 1 \times \frac{2}{3} \times \surd 2$; and is therefore thus found, in a comet whoſe perihelion diſtance is the radius of the *magnus orbis:*

$$3.14159 : \tfrac{2}{3}\sqrt{2} :: 365^{d}.6^{h}.9'.12'' \; (365.25639) : (109.61543) \; 109^{d}.14^{h}.46'.13''.$$

365.25639 =	2.5625978	Diurnal motion of comet 1682.		Comet 1664.
$\sqrt{2}$	0.1505150			
2	0.3010300	Log. perih.	9.765877	0.011044
		$\frac{1}{2}$	9.882939	5522
3	0.4771212			
3.14159	0.4971499	Perih. sesq.	9.648816	0.016566
			9.960128	9.960128
109.61543 =	2.0398717			
100.	2.	Log. d. mot.	0.311312	9.943562
0.9122802 =	9.9601283 Diurnal motion.			

Its diurnal motion therefore is 100, the number of parts that quadrant is divided into, divided by $109^{h}.14^{d}.46'.13''$, the time it is going it; that is, 0.912280, whose log. is 9.960128. Hence any other comet's diurnal motion is found; for velocity is reciprocally as the square root of the distance from the sun, and the sine of the angle (and therefore in small angles the angle itself) is reciprocally as the distance; the apparent motion therefore of a comet as seen from the sun, is reciprocally as the cube of the square root of its distance: the velocity being the root, the distance is the square, and the apparent motion the cube. The diurnal motion therefore, of which I have just given two examples, is perih. sesq. : 1 :: 0.912280 : diurnal motion.

The log. of diurnal motion thus found, saves the four lines used in finding it every time the comet's place is computed: the log. of the time between the comet's perihelion and time sought (reduced to decimals of a day, by table VII.) added to the log. of diurnal motion, gives the log. of mean motion, and if that is above 1.517428, its natural number is not wanted: find then in the parabolick table, N°. II. the article next below the mean motion sought, and say, difference : remainder :: 300'' : proportional parts :: difference of log. of distance : its proportional parts. Required the angle and log. of distance, answering to 1.519782; this is above $45°.15'$; then 986:378 :: 300 : 115 :: 263 : 101; the angle therefore is $45°.16'.55''$, and the log. of distance 0.069658. The next thing wanted is the comet's angle from the node: here, that we may always find it by addition, and save two lines in doing it by a single process, and not take it first from the perihelion, and thence from the node, I vary from Dr. Halley's method; for the article perih. post nodum is always the angle the comet moves, after passing its ascending node till it comes to the perihelion, be it more or less than 180 degrees; and using always the angle the comet has moved since

378	2.577		2.577
300	2.477	263	2.420
986	2.994		2.994
115 =	2.060	101 =	2.003

its

its laſt perihelion, (by taking the ſupplement to 360°, of the angle found by the parabolick table, if the place computed is before the comet's perihelion,) theſe two angles muſt always be added together, whether the comet is direct or retrograde, before or after its perihelion, and in whatever part of the orbit its node is; and rejecting 360° if neceſſary, if the angle is leſs than 180° the comet is in *north latitude*, if more, in *ſouth*. The tangent and ſine of this angle being uſed in the two next proportions, we muſt obſerve, that an angle, its ſupplement, and 180° more or leſs, have the ſame ſine and tangent, and that the angle reduced to the ecliptick, is always nearer 0, 180, or 360 degrees, than the angle from the node. So then R : coſ. of Incl. of the orbit : : tang. of angle from node : tang. of the angle on the ecliptick, which added to the place of the comet's node if direct, or ſubſtracted if retrograde, gives the *heliocentrick longitude*; as R : *s.* Incl. : : *s.* of angle from node : *s.* of *heliocentrick latitude.*

Again, the log. of the comet's perihelion diſtance, + log. of its increaſed diſtance as above found, + coſ. of heliocentrick latitude, gives the projection of the comet's place on the plain of the ecliptick, and the ſun's place and diſtance from the earth being found, in the triangle SCE, fig. 10, are given SC, SE, and CSE, therefore the leſſer ſide is to the greater, as R : tang. of an angle, and R : tang. of that angle — 45° : : tangent of half the ſum : tang. of half the difference of the two other angles; then $\frac{1}{2}$ the ſum + $\frac{1}{2}$ the difference being the greater, and $\frac{1}{2}$ ſum — $\frac{1}{2}$ difference the leſſer angle, the comet's *geocentrick longitude* is thence known. Laſtly, EC : SC, that is, ſine of angle at the ſun : ſine of angle at the earth : : tang. of heliocentrick latitude : tang. of *geocentrick*. Taking out natural numbers being troubleſome and liable to error, I avoid it as much as may be; for inſtance, when the ſine of the heliocentrick latitude is 9.852389, which is above 45°. 23′, its coſine and tangent are wanted, but not the angle itſelf; then difference of ſine is to difference of tangent, as remainder of ſine to remainder of tangent; 21 : 42 : : 18 : 36 for the tangent, which is therefore 10.005847, as the coſine is 9.846542. In like manner let 10.261606 be the tangent of an angle above 61°. 17′. 50″; then the tangent of 45° leſs, or above 16°. 17′. 50″ is thus found, 50 : 78 : : 27 : 42, the tangent then is 9.465972.

78	1.892
27	1.431
50	1.699
42	1.624

	Caille's Comet of 1739.			*Barker's Comet of Jan.* 1742.		
Log. diurn. mot.	0.217546	May	17d.8h.39'	0.130344	Feb.	18d. 8h.32'
Time 20.0556	1.302236	Perih. June	6.9.59	20.7368 1.316742	Jan.	28.14.51
			20.1.20			20.17.41
Log. mean mot.	1.519782		1.12	1.447086		16.48
Natural number			7.12	27.9954		43.12
Angle	45°.16'.55"	378.577	577 52	39°.23'.34"	495.695	695 8 38
Supplement	314.43.5	300.477	263.420		300.477	226.354 1 09
Perih. post node	104.46.34	986.994	994	328.30.10	694.841	841
		115.060	101.003		214.331	161.208
Ang. from node	59.29.39			7.53.44		
Cos. Inclination	9.750778	3s.8°.17'.35" 23	0.006154 37 3	9.582340	3s.8°.20'.37" 8	9.996519 11
T. ang. from node	10.229750		⊖'s dist. a ⊙ 6194	9.142021		⊖'s dist. a ⊙ 530
Tangent of angle	9.980528			8.724361		
on ecliptick	43°.42'.58"			3°.2'.4"		
Sine of Inclinat.	9.917095			9.965701		
S. ang. from node	9.935294			9.137884		
S. helioc. lat.	9 852389	6s.12°.13'.42" 4.15.1.38 19.43 1.36	10.27.36.39 3.8.17.58 + 1.1.13	9.103585	6s.12°.26'.49" 1.18.17.40 19.43 1.19	8.1.5.31 3.8.20.45 + 1.42.52
Helioc. lat.						
Long.	♍ 13°.42'.16"			♎ 2°.7'.26"		
Log. of perih.	9.828388	1739, May 17. 8h 39'	Sun's place 2.6.55.50	9.886522	1742, Feb. 18. 8h 32'	Sun's place 11.11.9.8
Log. of distance	0.069658			0.052367		
Cos. helioc. lat.	9.846542			9.996473		
Curtate distance	9.744588			9.935362		
Earth from sun	0.006194			9.996530		
Tangent	10.261606	78	8s. 6°.55'.50"	10.061168	33½	6s. 2°. 7'.26"
Angle	61°.17'.50"	27	5.13.42.16	49°.1'.10"	301	5.11.9.8
		50	2.23.13.34			20.58.18
T. of ang. — 45°	9.465972	42	3.6.46.26	8.846994	42½	159.1.42
Tang. of ½ sum	10.051465	½ sum	48.23.13	10.732633	238	79.30.51
		½ diff.	18.13.14			20.48.0
Tang. of ½ diff.	9.517437		66.36.27	9.579627	54	100.18.51
S. ang. at earth	9.701147		30.9.59	9.931756	167	58.42.51
Tang. helioc. lat.	10.005847		See fig 10.	9.107112	165	See fig. 11.
S. ang. at sun	9.996958			9.553769	55	
Tang. geoc. lat.	9.710036		Place observed.	9.485099		Place observed.
Geocent. lat.	N. 27°.9'.10"	N.	27°.9'	N. 16°.59'.30"		N. 16°.58'
Long.	♋ 7.5.50	♋	7.6	♑ 12.26.20		♑ 12.24

Besides calculating a comet's place, the parabolick table may be used in drawing any *parabola*. For, first, the natural number of the log. of distance at any angle, is the distance of that point of the parabola from the focus, in parts of the focal length; thus any number of points may be set off, by the angle from the vertex, and distance from the focus. Thus the log.

log. of distance at 42 degrees from the vertex is 0.059697; its natural number 1.14735, that point of the parabola therefore is distant from the focus about $1\frac{1}{7}$ of the focal length.

Secondly, One process reduces this distance from the focus, to any other known measure: as let the focal length of a parabola be 3.6 inches; then a point 42 degrees of angle from the vertex is 4.1305 inches from the focus

Log. dist.	0.059697
3.6	0.556302
	0.615999
Dist. in inches	4.1305

Thirdly, The angle in a parabola, at a great distance from the vertex, alters very little; in that case therefore, the points may perhaps be better set off, by the distances from the focus and from the axis, that is, the ordinate; which is thus found, R : *s.* ang. from vertex : : dist. from focus : ordinate. And if it be thought better, it may be done by the ordinate and abscissa, which is always one focal length less than the distance from the focus. Take for instance the ordinate, distance from focus, and abscissa at 170 degrees from the vertex, both in parts of the focal length and inches.

S. 170° —	9.239670		9.239670
Dist. a foc.	2.119408	In.	2.119408
Focal length		3.6 =	0.556302
Ordinate	1.359078		1.915380
	22.8601	Inches	82.2962
Dist. a foc.	131.6461		473.9254
Abscissa	130.6461		470.3254

Fourthly, But the best way to draw a comet's orbit round the sun is, marking the points at some certain interval from each other, as suppose 4, 8, 12, &c. days motion from the perihelion; hereby the point the comet is in at any time may quickly be known. To find these points, multiply the comet's diurnal motion by the number of days; the angle in the table corresponding to that, is the angle it is from the perihelion; as the corresponding log. of distance + log. of perihelion distance, gives the distance from the sun, in parts of the *magnus orbis.* Try the comet of 1682, 40 days from its perihelion.

Fifthly, When a comet whose perihelion distance is very small, is a great way from the sun, its angle from the perihelion alters very slowly; the points therefore, if thought better, may be laid out by the distances from the sun and from the axis, as just now proposed in the third use. Find then the angle distance and ordinate of the comet of 1680, at 120 days from its perihelion. Yet if when a comet is much further from the sun than the earth is, its

Log. diur. mot.	0.311312
40 days	1.602060
	1.913372
Ang. from per.	82°. 9′
Log. dist.	0.245413
Log. perih.	9.765877
	0.011290
Comet from sun	1.0263
Log. diur. mot.	3.279469
120 days	2.079181
	5.358650
Angle	174°.30′.35″
Log. dist.	2.639480
Log. perih.	7.787106
2.6705 =	0.426586
S. of angle	8.980807
	9.407393
Ordinate	0.2555

angle

angle be not set off in the *magnus orbis*, but on a larger concentrick circle, it will I believe be as well done, by the angle from the perihelion and distance from the sun.

In this manner the angle, distance and ordinate of the comet of 1680, and the angle and distance of that of 1682, are given for every fourth day from the perihelion, as far as they can be seen, in table VIII. Table IX. gives the length of the abscissa and ordinate of a parabola, in parts of the focal length, for every tenth degree, and oftener at last. And table X. gives the hourly motion of a comet, at different distances from the sun, (which is as the square root of its distance,) both in parts of the earth's mean distance, and in miles, supposing the earth 77,000,000 of miles from the sun, that is the sun's parallax 10 ½ seconds; and the times which comets of different perihelion distances take to go from their perihelion to their *latus rectum*; which are to one another as the square root of the cube of their perihelion distance, as I mentioned above in page 18.

Sixthly, As to the use of the table in the parabolick motion of projectiles, see fig. 7. The abscissa P Q, which is the height they rise, is always equal to S C — S P, that is one less than the distance from the focus, which is given by the table: the horizontal distance they fly, is twice the ordinate C Q: and Q T (= 2 P Q, that is twice the abscissa) is to C Q (the ordinate) as radius to cot. of Q C T, the angle of elevation.

Calculating a comet's place by a parabola, which is a very regular figure, has no proper difficulty in it; yet, being full 30 lines besides the sun's place, *&c.* is tedious; therefore an easy way to construct a comet's place may be very useful, where only a general account of a comet's motion is wanted, though by no means sufficient where nicety is required. See then fig. 9. On a sheet of pasteboard draw a circle five or ten inches radius for the *magnus orbis*, the center of which is the sun; and the real distance of the earth may be marked about the eighth degree of each sine, a little without the circle from ♎ to ♈, and a little within it from ♈ to ♎; and divide the circle into signs and degrees. From the table of elements, N°. I. mark true, both as to angle and distance, the perihelion of the comet required: through the sun draw the axis of the parabola, and by article 4. of the uses of the parabolick table, (page 21) set off the several points of the orbit, where the comet is at every fourth day's interval, on on each side of its perihelion. But as comets do not move in the plain of the ecliptick, on the proper angle, draw through the sun its line of nodes, and from the several points of the orbit, let fall perpendiculars upon it; on them mark a fresh row of points, whose distance from the line of nodes shall each be to their respective perpendiculars, as the cosine of the inclination of the comet's orbit is to radius. These points, which for distinction I make little crosses, form the curve of the projection of the comet's orbit on the plain of the ecliptick, which is always used in constructing a comet's place, and is, as Caille shews, art. 519 of his astronomy, itself also a parabola,

rabola, yet has by no means the same focus or position of axis, as the orbit itself; as would more plainly appear, by drawing the comet of 1577. For better distinction, the parabola itself is a fine stroke; the figures are written on that side of the orbit which is farthest from the line of nodes, and consequently from the projection of the orbit on the ecliptick; and the titles of the comets, are written the same way as the comet moves. Thus is the orbit of a comet made ready for use at any time, and its apparent place may be thus found:

Count the days from the comet's perihelion to the time required, and mark the point in the projection of the orbit, over which the comet then is; lay one edge of a parallel rule, from that point to the place of the earth at the same time, and the other edge passing through the sun, will cut the *magnus orbis* in the apparent longitude of the comet. Again, draw two right lines, cutting each other in the angle of the comet's inclination; from their intersection set off in one of them the length of the perpendicular from the comet's curtate place to the line of nodes, and a perpendicular erected to the other is the tangent of the comet's apparent latitude, making the curtate distance of the comet from the earth the radius. Thus may first, the course of a known comet quickly be traced, and in what part of the heavens to expect first to see it, when it returns again, be found; for since the period of no comet is yet known exactly, and for the reasons mentioned in page 5, they will not perhaps be always equal, we cannot fix the very month a comet will return in; and should therefore know where to look, if it comes a little sooner or later than is expected. Secondly, when a known comet returns, one observation will, with this scheme, shew its whole future course; for from the earth's place, at the time of observation, draw a line in the observed longitude of the comet, this cuts the projection of the comet's orbit in the place where it then was, whether the latitude agrees may be tried as above directed; and the day's motion marked on that curve, will shew where it will be at any other time. Thirdly, the periods of comets may perhaps be sometimes found by this scheme, when the observations are too defective to calculate the orbit by. For instance, no comet seen in August in ♒ can be that of 1682, nor can one seen in June easily be that of 1680, which must be then close to or beyond the sun, but one seen in January between ♒ and ♊ may; it remains then to try, whether the latitude, motion, and other circumstances agree with what might be expected of that comet, and as they agree or not, there is a probability of its being the same, or a proof that it is not.

I have chosen as an example of this method of constructing, the comet of 1682, which is shortly expected to return; and in twelve short tables, N°. XI. supposing its perihelion any month in the year, shew what the apparent course of the comet would be, which are very different one from another; for as appears on view, from April to November it would move direct, be in some of the signs from ♈ counting forward to ♐, and chiefly

in

in north latitude: between November and April it would be retrograde, between ♊ and ♍ counting backward, and be seen, disappear, and be seen again: that if seen about the beginning of summer, being at or a little after its perihelion, it would make the best shew, and be seen the shortest time; but will make very little figure in winter. The two first articles in each table, are the place about which the comet might be first seen, if its perihelion should prove that day which is set at the head of the table; for instance, if its next perihelion should be Sept. 23, whether 1757 or 1758, then about August 14 it may begin to be seen, being in 24 degrees of ♊, with 7 or 8 degrees north latitude. These tables shew in general how the comet would move, but in the middle of its course cannot be depended upon for a nicety; as a small inaccuracy may occasion great error, if the comet should cross the *magnus orbis* in its descent toward the sun about the middle of October, or in its ascent about the beginning of May, when it may move 40° in a day: so also if its perihelion should be a week or fortnight different from what I have supposed, it may make a considerable variation in its track. The two known periods of this comet are indeed more different than one could suspect; for the last was not 75 years, and an equal interval would make its next perihelion July 25, 1757; but if this revolution should be as long as the former was, that is above 76 years, it cannot be till Oct. 25, 1758. Yet as the rest of the elements agree so well all the three times, we cannot but suppose them to be the same; and as I can see no principle in nature to make its period alternately longer and shorter, I can refer the different intervals to nothing but those irregularities to which comet's orbits are liable. Yet on this account I have in another table, N°. XII. shewn in what part of the heavens the comet may be expected to begin to be seen, in any month of the year; as suppose it first gets near enough to be seen the beginning of July, we find that its apparent motion will be then direct, its place the beginning of ♊, the latitude north and increasing, and that it will come to its perihelion about a month afterwards.

Thus I have treated of the motion of comets, the gradual discovery of it, the way to find their real path, and to trace it either with respect to the sun or the earth; by which means we may hope to know the times of their revolutions better hereafter. But of their nature and uses I have not ventuted to speak, chusing rather to leave such points as are at present so little, I may almost say not at all known, to those, if any such shall hereafter be, who by greater light afforded them shall be enabled to search deeper into those hidden works of God. The works of an infinite Creator are without number; knowledge, though so greatly increased of late, has by no means compleated the search into the works of nature; fresh subjects of admiration and praise will still appear, as long as God sees fit to continue men upon earth, I nor can suppose that increase of knowledge will then cease. The farther we search into the works of God, the more instances of power, wisdom,

wisdom, and goodness we continually meet with. *There are yet hid greater things than these be, for we have seen but a few of his works*, was a wise remark of the son of Syrach, when contemplating and praising God for his many and wonderful works; and the same acknowledgment we may still make. For to begin near home, multitudes of things, both inanimate, plants, and animals familiar to us, were unknown in former times; and great proofs of wisdom and goodness appear in their several properties, the plentiful provision made for the well-being and support of all, and the fitness of every thing to its proper end, yet new discoveries are continually made. But how greatly does our prospect enlarge, when we look on this world only as one small part of the works of our Creator, and on every other planet and comet as a scene of as many and still various wonders! nor can we regard the most distant bodies otherwise than as multiplied instances of the same power and wisdom: how greatly then, considered in this light, do *the heavens declare the glory of God!*

> These are thy glorious works, Parent of good
> Almighty; thine this universal frame
> Thus wondrous fair, thyself how wondrous then!
>
> MILTON.

To come then to the present point, *he hath made all things for their uses:* comets, which are much more numerous than the planets, are doubtless designed for as wise ends, yet being so very different from them, both in appearance and motion, serve probably to quite different purposes; and possibly we who inhabit a planet, can have no more idea of the design of a comet, than one who never knew any thing of hearing could have of the use of an ear; he might justly conclude, that so artful a machine was not placed in the head for nothing, and so may we of comets, but the real intention we could in neither case find out. The appearance of a comet's tail is very surprizing, and various have been the guesses at the cause of it; Sir Isaac Newton's I think as plausible as any; yet it is much easier to make objections against any of the opinions, than to give a better.

I mean not hereby to discourage inquiry into the nature and uses of comets; no, there is scarce any employment better becomes a creature, than searching into any of the works of the great Creator. Yet let us not stop at the discovery of the works, but be thereby led to acknowledge the workmaster. *If we are astonished at their power and virtue, let us understand how much mightier he is that made them.* If we observe the uniformity of that universal principle of gravity, let us consider the infiniteness of that one God, who in so wonderful yet hidden a manner, restrains the amazing swiftness of such vast bodies, by a power which yet does not hinder the least creature of its proper motion. When we see that the same power which guides those numberless, vast, and immensely distant bodies, is yet

not unmindful of the most minute, we must remember, that he who regards the good of the merely sensitive beings, will much more observe in every action, how we employ that reason he has entrusted us with: that nothing can be concealed from him who made all things; that one constantly employed in doing good cannot be pleased with trifling, nor the wise with folly; that the holy cannot but hate wickedness, the just abhor injustice, and the merciful detest cruelty; and that the all-powerful maker and ruler of the world, must needs in due time distinguish between *him that serveth God, and him that serveth him not:* and above all, that no swiftness can escape him, who threw the astonishingly swift planets and comets, and guides the still much more impetuous light; no distance avoid him, who is not confined to the entire solar system, nor to those multitudes of others, of which we can but just discover the central bright point; that no craft can deceive him from whom all the wisdom in the world is derived; and no power resist him, at whose rebuke the earth trembles, and the very foundations of the hills shake; nor can any greatness protect from him, who *made the small as well as the great, and careth for all alike,* and by whose stroke the greatest monarch is reduced to the same mouldering dust as the lowest of his subjects.

Again, if we admire the wisdom of God as shewn forth in his works, wonder at those inconceivably vast regions of light, the nebulous stars; the surprizing singularity of saturn's ring; and the entire diversity of the comets from the planets; whose uses are all too far beyond our ken to discover: and to come more within our own view, if we remark that wonderful instinct, by which *the swallow knoweth his appointed time;* the careful sorting of proper fruits and creatures, to all the so various climates on our own earth; and the no less surprizing diversity of inhabitants, allotted to such different mediums as air, water, earth, and still harder substances; and the connecting links as it were in the chain of beings, which are between plants and animals, air and water creatures, beasts and birds, *&c.* let none then pretend to be wiser than God, or above being taught by him; for as we cannot but know it is our interest to please him in whose power we entirely are, so it is as certain, that none knows his will so well as he does himself: nor can there well be a greater folly, than to prefer the uncertain deductions of frail, created reason, (which 4 or 5000 years experience shewed can never form a uniform system of morality; though it could not refuse its assent, when christianity had explained it;) to the clear discoveries, I do not say of unauthorized human glosses, but of the genuine revelations from perfect, self-existent wisdom. Two extreams are here to be avoided; either despising that noble faculty, and glory of man, *reason,* and refusing to see any thing, because we cannot see every thing; this is slighting the gift of God, hiding our talent in the earth, and tends to *enthusiasm:* or on the other hand so glorying in it, as to forget it is the gift of God, and preferring a candle to the light of the sun when offered;

offered; this is deſpiſing God himſelf, refuſing to ſubmit to his governance, and tends to *atheiſm*. Laſtly, if on a review of the whole we may juſtly ſay, *the works of the Lord are great, ſought out of all them that have pleaſure therein*; it will appear from contemplating them, that *there is one wiſe and greatly to be feared, the Lord ſitting on his throne:* and as it is plain, that *the Lord is king, be the people never ſo impatient*, ſo it is as true, when we conſider his extenſive wiſdom and goodneſs, that *the earth may be glad thereof.* When therefore, reflecting on the power, wiſdom, and goodneſs of God, as ſhining forth in his mighty works, *you glorify the Lord, exalt him as much as you can, for even yet he will far exceed; and when you exalt him put forth all your ſtrength, and be not weary, for you can never go far enough.*

TABLE

Time of Perihelion.						Perih. Dist.	Log. of it.	L. D. Mo.	Place of Perih.				Per. p. Nod.		
1264	July	6^d	8^h	′	″	44500	9.648360	0.487588	♑^s	21°	′	″	122°	′	″
1337	June	2	6	25		40666	9.609236	0 546274	♉	7	59	0	46	22	0
1472	Feb.	28	22	23		54273	9.734584	0.358252	♉	15	33	30	236	12	50
1531	Aug.	24	21	18	30	56700	9.753583	0.329754	♒	1	39	0	107	46	0
1532	Oct.	19	22	12		50910	9.706803	0.399924	♋	21	7	0	30	40	0
1533	June	16	19	30	0	20280	9.307068	0.999526	♌	27	16	0	338	28	0
1556	April	21	20	3		46390	9.666424	0.460492	♑	8	50	0	103	8	0
1577	Oct.	26	18	45		18342	9.263447	1.064958	♌	9	22	0	256	30	0
1580	Nov.	28	15	0		59628	9.775450	0.296953	♋	19	5	50	90	8	30
1585	Sept.	27	19	20		1.09358	0.038850	9.901853	♈	8	51	0	331	8	30
1590	Jan.	29	3	45		57661	9.760882	0.318805	♏	6	54	30	308	36	10
1593	July	8	13	38		08911	8.949940	1.535218	♍	26	19	0	12	4	45
1596	July	31	19	55		51293	9.710058	0.395041	♏	18	16	0	83	56	30
1607	Oct.	16	3	50		58680	9.768490	0.307393	♒	2	16	0	108	5	0
1618	Oct.	29	12	23		37975	9.579498	0.590881	♈	2	14	0	286	13	0
1652	Nov.	2	15	40		84750	9.928140	0.067918	♈	28	18	40	300	8	40
1661	Jan.	16	23	41		44851	9.651772	0.482470	♋	25	58	40	33	28	10
1664	Nov	24	11	52		1.02575 ½	0.011044	9.943562	♌	10	41	25	310	32	35
1665	April	14	5	15	30	10649	9.027309	1.419164	♊	11	54	30	156	7	30
1672	Feb.	20	8	37		69739	9.843476	0 194914	♉	16	59	30	109	29	0
1677	April	26	0	37	30	28059	9.448072	0.788020	♌	17	37	5	99	12	5
1678	Aug.	16	14	3	0	1.23802	0.092727	9.821037	♒	27	46	0	166	6	0
1680	Dec.	8	0	6		00612 ½	7.787106	3.279469	♐	22	39	30	350	37	30
1682	Sept.	4	7	39		58328	9.765877	0.311312	♒	2	52	45	108	23	45
1683	July	3	2	50		56020	9.748343	0.337614	♊	25	29	30	87	53	30
1684	May	29	10	16		96015	9.982339	9.986620	♏	28	52	0	330	37	0
1686	Sept.	6	14	33		32500	9.511883	0.692304	♊	17	0	30	86	25	50
1698	Oct.	8	16	57		69129	9.839660	0.200638	♑	0	51	15	356	53	0
1699	Jan.	3	8	22		74400	9.871570	0.152773	♏	2	31	6	289	14	29
1702	Mar.	2	14	12		64590	9.810165	0.244881	♌	18	41	3	309	15	48
1706	Jan.	19	4	22		42581	9.629218	0.516301	♊	12	29	10	59	17	30
		19	4	56	0	42686 ½	9.630291	0.514692		12	36	25	59	25	2
1707	Nov.	30	23	29		85974	9.934368	0.058576	♊	19	54	56	27	8	21
		30	23	43	6	85904	9.934013	0.059109		19	58	9	27	7	40
1718	Jan.	4	1	14	55	1.02565	0.010999	9.943629	♌	1	26	36	6	28	50
		3	23	38		1.02655	0 011380	9.943058		1	30	0	7	13	0
		4	7	48		1.02743	0.011753	9.942499		1	3	40	7	17	20
1723	Sept.	16	16	10		99865	9.999414	9.961007	♉	12	52	20	331	23	40
1729	June	14	10	56		4.26140	0.629552	9.015800	♒	22	40	0	12	7	23
		12	6	35	41	4.06980	0.609573	9.045769			16	53	11	41	38
1737	Jan.	19	8	20		22282	9.347960	0.938188	♒	25	55	0	99	33	0
1739	June	6	9	59		67358	9.828388	0.217546	♋	12	38	40	104	46	34
		9	9	14		69614	9.842697	0.196083		5	11		110	7	
1742	Jan.	28	4	38		76568	9.884049	0.134055	♏	7	35	13	328	3	16
		28	4	20	50	76555 ¼	9.883693	0.134589		7	33	44	328	1	1
		28	14	51		77005 ½	9.886523	0.130344		6	39	20	328	30	10
1742	Dec.	30	20	25		83501	9.921690	0.077593	♋	2	41	45	14	20	30
		30	21	15	16	83811 ½	9 923304	0.075172		2	58	4	24	47	16
1743	Sept.	9	21	16	18	52157	9.717313	0.384159	♐	6	33	52	118	42	33
1744	Feb.	19	8	12		22206	9.346472	0.940420	♎	17	12	55	151	27	35
		19	8	3		22250	9.347325	0.939141	·	17	10	0	151	23	49
1747	Feb.	20	7	10		2.10851	0.342128	9.446936	♑	7	2	0	230	16	50
		17	11	44	38	2.29388	0.360571	9.419272		10	5	41	226	52	46
1748	April	17	19	25		84066 ½	9.924624	0.073192	♏	5	0	50	17	51	25
1748	June	7	1	24	15	65525 ½	9.816410	0.235513	♑	6	9	24	241	29	41

Aſcending Node.				Inclination			Coſ. of it.	Sine of it.		Calculator.	
♍ˢ	19°	′	″	36°	30′	″	9.905179	9.774388	Direct	Dunthorne.	
♊	24	21	0	32	11	0	9.927549	9.726426	Retrog.	Halley.	
♑	11	46	20	5	20	0	9.998116	8.968249	Retrog.	Halley.	
♉	19	25	0	17	56	0	9.978370	9.488424	Retrog.	Halley.	
♊	20	27	0	32	36	0	9.925545	9.731404	Direct	Halley.	
♌	5	44	0	35	49	0	9.908964	9.767300	Retrog.	Downes.	(See p. 13.)
♍	25	42	0	32	6	30	9.927906	9.725521	Direct	Halley.	
♈	25	52	0	74	32	45	9.425644	9.984007	Retrog.	Halley.	
♈	18	57	20	64	40	0	9.631326	9.956089	Direct	Halley.	
♉	7	42	30	6	4	0	9.997561	9.024016	Direct	Halley.	
♍	15	30	40	29	40	40	9.938932	9.694712	Retrog.	Halley.	
♍	14	14	15	87	58	0	8.549995	9.999726	Direct	C.	
♒	12	12	30	55	12	0	9.756418	9.914422	Retrog.	Halley.	
♉	20	21	0	17	2	0	9.980519	9.466761	Retrog.	Halley.	
♊	16	1	0	37	34	0	9.899078	9.785105	Direct	Halley.	
♊	28	10	0	79	28	0	9.261994	9.992619	Direct	Halley.	
♊	22	30	30	32	35	50	9.925559	9.731371	Direct	Halley.	
♊	21	14	0	21	18	30	9.969247	9.560369	Retrog.	Halley.	
♏	18	2	0	76	5	0	9.381134	9.987061	Retrog.	Halley.	
♑	27	30	30	83	22	10	9.062457	9.997085	Direct	Halley.	
♏	26	49	10	79	3	15	9.278481	9.992026	Retrog.	Halley.	
♍	11	40	0	3	4	20	9.999375	8.729122	Direct	Downes.	
♑	2	2	0	60	56	0	9.686482	9.941539	Direct	Halley.	
♉	21	16	30	17	56	0	9.978370	9.488424	Retrog.	Halley.	
♍	23	23	0	83	11	0	9.074424	9.996919	Retrog.	Halley.	
♐	28	15	0	65	48	40	9.612515	9.960090	Direct	Halley.	
♓	20	34	40	31	21	40	9.931409	9.716363	Direct	Halley.	
♐	27	44	15	11	46	0	9.990777	9.309474	Retrog.	Halley.	
♌	21	45	35	69	20	0	9.547689	9.971113	Retrog.	Caille.	(See p. 13.)
♎	9	25	15	4	30	0	9.998659	8.894643	Direct	Caille.	
♈	13	11	40	55	14	10	9.756024	9.914612	Direct	C.	
	13	11	23	55	14	5	9.756039	9.914605		Struijck.	
♉	22	46	35	88	36	0	8.387962	9.999870	Direct	C.	
	22	50	29	88	37	40	8.379260	9.999875		Struijck.	
♌	7	55	20	31	12	53	9.932083	9.714536		Downes.	
	8	43	0	30	20	0	9.936062	9.703317	Retrog.	C.	(See p. 13.)
	8	21	0	30	48	30	9.933940	9.709398		Whiſton.	
♈	14	16	0	49	59	0	9.808218	9.884148	Retrog.	Bradley.	
♒	10	32	37	76	58	4	9.353126	9.988667	Direct	C.	
	10	35	15	77	1	58	9.351010	9.988781		Downes.	
♏	16	22	0	18	20	45	9.977346	9.497968	Direct	Bradley.	
♎	27	25	14	55	42	44	9.750778	9.917095	Retrog.	Caille.	
	25	18		53	25		9.775240	9.904711		Zanotti.	(See p. 13.)
♎	5	38	29	66	59	14	9.592106	9.963985		C.	
	5	34	45	67	4	11	9.590631	9.964250	Retrog.	Struijck.	
	5	9	30	67	31	40	9.582340	9.965701		Barker.	(See p. 13.)
♊	18	21	15	2	19	33	9.999642	8.608337	Direct	C.	
	8	10	48	2	15	50	9.999661	8.596619		Struijck.	
♈	5	16	25	45	48	21	9.843290	9.855508	Retrog.	Klinkenberg.	
♉	15	45	20	47	8	36	9.832616	9.865138	Direct	Betts.	
	15	46	11	47	5	18	9.833064	9.864751		C.	
♌	27	18	50	79	6	20	9.276462	9.992101	Retrog.	C.	
	26	58	27	77	56	55	9.319707	9.990321		Chezeaux.	
♏	22	52	15	85	27	0	8.899432	9.998629	Retrog.	Maraldi.	
♉	4	39	43	56	59	3	9.736293	9.923513	Direct	Struijck.	

TABLE II. *A general Table of the Parabola.*

Angle from Perihelion. °	'	Mean Mot.	Diff.	Log. Dist.	Diff.
°	'		—545		— 0
0	5	0.0545	546	0.000000	1
	10	0.1091	545	0.000001	1
	15	0.1636	546	0.000002	2
	20	0.2182	545	0.000004	2
	25	0.2727	545	0.000006	2
	30	0.3272	—546	0.000008	— 3
	35	0.3818	545	0.000011	4
	40	0.4363	546	0.000015	4
	45	0.4909	545	0.000019	4
	50	0.5454	546	0.000023	5
	55	0.6000	545	0.000028	5
1	0	0.6545	—546	0.000033	— 6
	5	0.7091	545	0.000039	6
	10	0.7636	546	0.000045	7
	15	0.8182	545	0.000052	7
	20	0 8727	546	0.000059	7
	25	0.9273	546	0.000066	8
	30	0.9819	—545	0.000074	— 9
	35	1.0364	546	0.000083	9
	40	1.0910	546	0.000092	9
	45	1.1456	545	0.000101	10
	50	1.2001	546	0.000111	10
	55	1.2547	546	0.000121	11
2	0	1.3093	—545	0.000132	—12
	5	1.3638	546	0.000144	11
	10	1.4184	546	0.000155	12
	15	1.4730	546	0.000167	13
	20	1.5276	546	0.000180	13
	25	1.5822	546	0.000193	14
	30	1.6368	—546	0.000207	—14
	35	1.6914	546	0.000221	14
	40	1.7460	546	0.000235	15
	45	1.8006	546	0.000250	16
	50	1.8552	546	0.000266	15
	55	1.9098	546	0.000281	17
3	0	1.9644	—546	0.000298	—16
	5	2.0190	546	0.000314	18
	10	2.0736	547	0.000332	17
	15	2.1283	546	0.000349	19
	20	2.1829	546	0.000368	18
	25	2.2375	547	0.000386	19
	30	2.2922	—546	0.000405	—20
	35	2.3468	547	0.000425	20
	40	2.4015	546	0.000445	20
	45	2.4561	547	0.000465	21
	50	2.5108	546	0.000486	21
	55	2.5654	547	0.000507	22
4	0	2.6201	—547	0.000529	—23
	5	2.6748	547	0.000552	22
	10	2.7295	547	0.000574	23
	15	2.7842	547	0.000597	24
	20	2.8389	547	0.000621	24
	25	2.8936	547	0.000645	25
	30	2.9483	—547	0.000670	—25

Angle. °	'	Mean Mot.	Diff.	Log. Dist.	Diff.
°	'		—547		—25
4	35	3.0030	547	0.000695	25
	40	3.0577	547	0.000720	26
	45	3.1124	548	0.000746	27
	50	3.1672	547	0.000773	27
	55	3.2219	547	0.000800	27
5	0	3.2766	—548	0.000827	—28
	5	3.3314	548	0.000855	28
	10	3.3862	547	0.000883	29
	15	3.4409	548	0.000912	29
	20	3.4957	548	0.000941	30
	25	3.5505	548	0.000971	30
	30	3.6053	—548	0.001001	—30
	35	3.6601	548	0.001031	31
	40	3.7149	548	0.001062	32
	45	3.7697	548	0.001094	32
	50	3 8245	548	0.001126	32
	55	3.8793	549	0.001158	33
6	0	3.9342	—548	0.001191	—33
	5	3.9890	549	0.001224	34
	10	4.0439	549	0.001258	35
	15	4.0988	548	0.001293	34
	20	4.1536	549	0.001327	35
	25	4.2085	549	0.001362	36
	30	4.2634	—549	0.001398	—36
	35	4.3183	549	0.001434	37
	40	4.3732	549	0.001471	37
	45	4.4281	549	0.001508	37
	50	4.4830	550	0.001545	38
	55	4.5380	549	0.001583	39
7	0	4.5929	—550	0.001622	—39
	5	4.6479	549	0.001661	39
	10	4.7028	550	0.001700	40
	15	4.7578	550	0.001740	40
	20	4.8128	550	0.001780	41
	25	4.8678	550	0.001821	41
	30	4.9228	—550	0.001862	—41
	35	4.9778	550	0.001903	42
	40	5.0328	551	0.001945	43
	45	5.0879	550	0.001988	43
	50	5.1429	551	0.002031	43
	55	5.1980	551	0.002074	44
8	0	5.2531	—550	0.002118	—45
	5	5.3081	551	0.002163	45
	10	5.3632	551	0.002208	45
	15	5 4183	551	0.002253	46
	20	5.4734	552	0.002299	46
	25	5.5286	551	0.002345	47
	30	5.5837	—552	0.002392	—47
	35	5.6389	551	0.002439	48
	40	5.6940	552	0.002487	48
	45	5.7492	552	0.002535	48
	50	5.8044	552	0.002583	49
	55	5.8596	552	0.002632	50
9	0	5.9148	—552	0.002682	—50

Angle.	Mean Mot.	Diff.	Log. Dift.	Diff.	Angle.	Mean Mot.	Diff.	Log. Dift.	Diff.
° '					° '				
9 5	5.9700	—552	0.002732	—50	13 35	8.9744	—561	0.006117	— 75
10	6.0253	553	0.002782	50	40	9.0305	561	0.006192	75
15	6.0805	552	0.002833	51	45	9.0866	561	0.006268	76
20	6.1358	553	0.002884	51	50	9.1428	562	0.006344	76
25	6.1911	553	0.002936	52	55	9.1989	561	0.006421	77
30	6.2464	553	0.002988	52	14 0	9.2551	562	0.006498	77
35	6.3017	—553	0.003041	—53	5	9.3113	—562	0.006576	— 78
40	6.3570	553	0.003094	53	10	9.3676	563	0.006655	79
45	6.4123	553	0.003148	54	15	9.4238	562	0.006733	78
50	6.4677	554	0.003202	54	20	9.4801	563	0.006813	80
55	6.5230	553	0.003257	55	25	9.5364	563	0.006892	79
10 0	6.5784	554	0.003312	55	30	9.5927	563	0.006972	80
5	6.6338	—554	0.003367	—55	35	9.6490	—563	0.007053	— 81
10	6.6892	554	0.003423	56	40	9.7054	564	0.007134	81
15	6.7446	554	0.003479	56	45	9.7617	563	0.007216	82
20	6.8000	554	0.003536	57	50	9.8181	564	0.007298	82
25	6.8555	555	0.003594	58	55	9.8745	564	0.007380	82
30	6.9109	554	0.003652	58	15 0	9.9310	565	0.007463	83
35	6.9664	—555	0.003710	—58	5	9.9874	—564	0.007546	— 83
40	7.0219	555	0.003769	59	10	10.0439	565	0.007630	84
45	7.0774	555	0.003828	59	15	10.1004	565	0.007714	84
50	7.1329	555	0.003887	59	20	10.1569	565	0.007799	85
55	7.1885	556	0.003947	60	25	10.2135	566	0.007884	85
11 0	7.2440	555	0.004008	61	30	10.2701	566	0.007970	86
5	7.2996	—556	0.004069	—61	35	10.3267	—566	0.008056	— 86
10	7.3551	555	0.004131	62	40	10.3833	566	0.008143	87
15	7.4107	556	0.004193	62	45	10.4399	566	0.008230	87
20	7.4663	556	0.004255	62	50	10.4966	567	0.008318	88
25	7.5220	557	0.004318	63	55	10.5533	567	0.008406	88
30	7.5776	556	0.004381	63	16 0	10.6100	567	0.008494	88
35	7.6333	—557	0.004445	—64	5	10.6667	—567	0.008583	— 89
40	7.6890	557	0.004509	64	10	10.7234	567	0.008673	90
45	7.7447	557	0.004574	65	15	10.7802	568	0.008763	90
50	7.8004	557	0.004639	65	20	10.8370	568	0.008853	90
55	7.8561	557	0.004705	66	25	10.8938	568	0.008944	91
12 0	7.9118	557	0.004771	66	30	10.9507	569	0.009036	92
5	7.9676	—558	0.004838	—67	35	11.0076	—569	0.009127	— 91
10	8.0234	558	0.004905	67	40	11.0645	569	0.009220	93
15	8.0792	558	0.004973	68	45	11.1214	569	0.009312	92
20	8.1350	558	0.005041	68	50	11.1783	569	0.009406	94
25	8.1908	558	0.005109	68	55	11.2353	570	0.009499	93
30	8.2467	559	0.005178	69	17 0	11.2923	570	0.009593	94
35	8.3025	—558	0.005247	—69	5	11.3493	—570	0.009688	— 95
40	8.3584	559	0.005317	70	10	11.4063	570	0.009783	95
45	8.4143	559	0.005388	71	15	11.4634	571	0.009879	96
50	8.4702	559	0.005458	70	20	11.5205	571	0.009975	96
55	8.5262	560	0.005530	72	25	11.5776	571	0.010071	96
13 0	8.5822	560	0.005602	72	30	11.6348	572	0.010168	97
5	8.6381	—559	0.005674	—72	35	11.6919	—571	0.010266	— 98
10	8.6941	560	0.005746	72	40	11.7491	572	0.010364	98
15	8.7501	560	0.005819	73	45	11.8063	572	0.010462	98
20	8.8062	561	0.005893	74	50	11.8636	573	0.010561	99
25	8.8622	560	0.005967	74	55	11.9209	573	0.010660	99
30	8.9183	561	0.006042	75	18 0	11.9782	573	0.010760	100
		—561		—75			—573		—100

Angle		Mean Mot.	Diff.	Log. Dist.	Diff.	Angle		Mean Mot.	Diff.	Log. Dist.	Diff.
°	′		—573		—100	°	′		—589		—126
18	5	12 0355	573	0.010860	101	22	35	15.1741	590	0.016978	126
	10	12.0928	574	0.010961	101		40	15.2331	591	0.017104	127
	15	12.1502	574	0.011062	102		45	15.2922	590	0.017231	128
	20	12.2076	574	0.011164	102		50	15.3512	591	0.017359	127
	25	12.2650	575	0.011266	103		55	15.4103	592	0.017486	129
	30	12.3225	—575	0.011369	—103	23	0	15.4695	—591	0.017615	—128
	35	12.3800	575	0.011472	104		5	15.5286	592	0.017743	130
	40	12.4375	576	0.011576	104		10	15.5878	593	0.017873	129
	45	12.4951	575	0.011680	104		15	15.6471	592	0.018002	130
	50	12.5526	576	0.011784	105		20	15.7063	594	0.018132	131
	55	12.6102	577	0.011889	106		25	15.7657	593	0.018263	131
19	0	12.6679	—576	0.011995	—106		30	15.8250	—594	0.018394	—132
	5	12.7255	577	0.012101	106		35	15.8844	594	0.018526	132
	10	12.7832	577	0.012207	107		40	15.9438	594	0.018658	133
	15	12.8409	577	0.012314	107		45	16.0032	595	0.018791	133
	20	12.8986	578	0.012421	108		50	16.0627	596	0.018924	133
	25	12.9564	578	0.012529	108		55	16.1223	595	0.019057	134
	30	13.0142	—578	0.012637	—109	24	0	16.1818	—596	0.019191	—135
	35	13.0720	579	0.012746	109		5	16.2414	597	0.019326	135
	40	13.1299	579	0.012855	110		10	16.3011	596	0.019461	135
	45	13.1878	579	0.012965	110		15	16.3607	597	0.019596	136
	50	13.2457	579	0.013075	111		20	16.4204	598	0.019732	137
	55	13.3036	580	0.013186	111		25	16.4802	598	0.019869	136
20	0	13.3616	—580	0.013297	—112		30	16.5400	—598	0.020005	—138
	5	13.4196	580	0.013409	112		35	16.5998	599	0.020143	138
	10	13.4776	581	0.013521	112		40	16.6597	599	0.020281	138
	15	13.5357	581	0.013633	113		45	16.7196	599	0.020419	139
	20	13.5938	581	0.013746	114		50	16.7795	600	0.020558	139
	25	13.6519	581	0.013860	114		55	16.8395	600	0.020697	140
	30	13.7100	—582	0.013974	—114	25	0	16.8995	—601	0.020837	—140
	35	13.7682	582	0 014088	115		5	16.9596	600	0.020977	141
	40	13.8264	583	0.014203	116		10	17.0196	602	0.021118	141
	45	13.8847	583	0.014319	116		15	17.0798	602	0.021259	142
	50	13.9430	583	0.014435	116		20	17.1400	602	0.021401	142
	55	14.0013	583	0.014551	117		25	17.2002	602	0.021543	143
21	0	14.0596	—584	0.014668	—117		30	17.2604	—603	0.021686	—143
	5	14.1180	584	0.014785	118		35	17.3207	603	0.021829	144
	10	14.1764	584	0.014903	118		40	17.3810	604	0.021973	144
	15	14.2348	585	0.015021	119		45	17.4414	604	0.022117	144
	20	14.2933	585	0.015140	119		50	17.5018	605	0.022261	146
	25	14.3518	585	0.015259	120		55	17.5623	605	0.022407	145
	30	14.4103	—585	0.015379	—120	26	0	17.6228	—605	0.022552	—146
	35	14.4688	586	0.015499	121		5	17.6833	606	0.022698	147
	40	14.5274	587	0.015620	121		10	17.7439	606	0.022845	147
	45	14.5861	586	0.015741	121		15	17.8045	606	0.022992	147
	50	14.6447	587	0.015862	122		20	17.8651	607	0.023139	148
	55	14 7034	587	0.015984	123		25	17.9258	607	0.023287	149
22	0	14.7621	—588	0.016107	—123		30	17.9865	—608	0.023436	—149
	5	14.8209	588	0.016230	123		35	18.0473	608	0.023585	149
	10	14.8797	588	0.016353	124		40	18.1081	609	0.023734	150
	15	14.9385	589	0.016477	125		45	18.1690	609	0.023884	151
	20	14 9974	589	0,016602	125		50	18.2299	610	0.024035	151
	25	15.0563	589	0.016727	125		55	18.2909	610	0.024186	151
	30	15.1152	—589	0 016852	—126	27	0	18.3519	—610	0.024337	—152

Angle.		Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.		Mean Mot.	Diff.	Log. Dist.	Diff.
°	′		—610		—152	°	′		—636		—178
27	5	18.4129	611	0.024489	152	31	35	21.7766	636	0.033417	179
	10	18.4740	611	0.024641	153		40	21.8402	637	0.033596	180
	15	18.5351	611	0.024794	153		45	21.9039	638	0.033776	179
	20	18.5962	612	0.024947	154		50	21.9677	638	0.033955	181
	25	18.6574	613	0.025101	155		55	22.0315	638	0.034136	181
	30	18.7187	—613	0.025256	—154	32	0	22.0953	—639	0.034317	—181
	35	18.7800	613	0.025410	156		5	22.1592	640	0.034498	182
	40	18.8413	614	0.025566	156		10	22.2232	640	0.034680	182
	45	18.9027	614	0.025722	156		15	22.2872	641	0.034862	183
	50	18.9641	615	0.025878	157		20	22.3513	641	0.035045	184
	55	19.0256	615	0.026035	157		25	22.4154	642	0.035229	183
28	0	19.0871	—615	0.026192	—158		30	22.4796	—642	0.035412	—185
	5	19.1486	616	0.026350	158		35	22.5438	643	0.035597	185
	10	19.2102	617	0.026508	158		40	22.6081	643	0.035782	185
	15	19.2719	617	0.026666	160		45	22.6724	644	0.035967	186
	20	19.3336	617	0.026826	159		50	22.7368	645	0.036153	186
	25	19.3953	618	0.026985	160		55	22.8013	645	0.036339	187
	30	19.4571	—618	0.027145	—161	33	0	22.8658	—645	0.036526	—187
	35	19.5189	619	0.027306	161		5	22.9303	646	0.036713	188
	40	19.5808	619	0.027467	162		10	22.9949	647	0.036901	189
	45	19.6427	620	0.027629	162		15	23.0596	647	0.037090	188
	50	19.7047	620	0.027791	163		20	23.1243	648	0.037278	190
	55	19.7667	621	0.027954	163		25	23.1891	649	0.037468	190
29	0	19.8288	—621	0.028117	—163		30	23.2540	—649	0.037658	—190
	5	19.8909	621	0.028280	164		35	23.3189	649	0.037848	191
	10	19.9530	622	0.028444	165		40	23.3838	650	0.038039	191
	15	20.0152	622	0.028609	165		45	23.4488	651	0.038230	192
	20	20.0774	623	0.028774	166		50	23.5139	651	0.038422	193
	25	20.1397	624	0.028940	166		55	23.5790	652	0.038615	192
	30	20.2021	—624	0.029106	—166	34	0	23.6442	—653	0.038807	—194
	35	20.2645	624	0.029272	167		5	23.7095	653	0.039001	194
	40	20.3269	625	0.029439	168		10	23.7748	653	0.039195	194
	45	20.3894	625	0.029607	168		15	23.8401	654	0.039389	195
	50	20.4519	626	0.029775	168		20	23.9055	655	0 039584	195
	55	20.5145	626	0.029943	169		25	23.9710	656	0.039779	196
30	0	20.5771	—627	0.030112	—170		30	24 0366	—656	0.039975	—197
	5	20.6398	627	0.030282	170		35	24.1022	656	0.040172	196
	10	20 7025	628	0.030452	170		40	24.1678	657	0.040368	198
	15	20.7653	628	0.030622	171		45	24.2335	658	0.040566	198
	20	20.8281	629	0 030793	172		50	24.2993	658	0.040764	198
	25	20.8910	629	0.030965	172		55	24.3651	659	0.040962	199
	30	20.9539	—630	0.031137	—172	35	0	24 4310	—660	0.041161	—199
	35	21.0169	630	0.031309	173		5	24.4970	660	0.041360	200
	40	21.0799	631	0.031482	174		10	24.5630	661	0.041560	201
	45	21.1430	631	0.031656	174		15	24.6291	661	0.041761	201
	50	21.2061	632	0.031830	174		20	24.6952	662	0.041962	201
	55	21.2693	633	0.032004	175		25	24.7614	663	0.042163	202
31	0	21.3326	—632	0.032179	—175		30	24.8277	—663	0.042365	—202
	5	21.3958	634	0.032354	176		35	24.8940	664	0.042567	203
	10	21.4592	634	0.032530	177		40	24.9604	664	0.042770	204
	15	21.5226	634	0.032707	177		45	25.0268	665	0.042974	204
	20	21.5860	635	0.032884	177		50	25.0933	666	0.043178	204
	25	21.6495	635	0.033061	178		55	25.1599	666	0.043380	205
	30	21.7130	—636	0.033239	—178	36	0	25.2265	—667	0.043587	—206

Angle. °	′	Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	′	Mean Mot.	Diff.	Log. Dist.	Diff.
36	5	25.2932	—667	0.043793	—206	40	35	28.9946	—704	0.055650	—233
	10	25.3600	668	0.043999	206		40	29.0652	706	0.055884	234
	15	25.4268	668	0.044205	206		45	29.1358	706	0.056119	235
	20	25.4937	669	0.044412	207		50	29.2064	706	0.056353	234
	25	25.5607	670	0.044620	208		55	29.2772	708	0.056589	236
	30	25.6277	670	0.044828	208	41	0	29.3480	708	0.056825	236
	35	25.6948	—671	0.045037	—209		5	29.4189	—709	0.057061	—236
	40	25.7619	671	0.045246	209		10	29.4899	710	0.057298	237
	45	25.8291	672	0.045455	209		15	29.5609	710	0.057536	238
	50	25.8964	673	0.045665	210		20	29.6320	711	0.057774	238
	55	25.9637	673	0.045876	211		25	29.7032	712	0.058012	238
37	0	26.0311	674	0.046087	211		30	29.7745	713	0.058251	239
	5	26.0986	—675	0.046298	—211		35	29.8459	—714	0.058491	—240
	10	26.1661	675	0.046511	213		40	29.9173	714	0.058731	240
	15	26.2337	676	0.046723	212		45	29.9888	715	0.058971	240
	20	26.3014	677	0.046936	213		50	30.0604	716	0.059213	242
	25	26.3691	677	0.047150	214		55	30.1321	717	0.059454	241
	30	26.4369	678	0.047364	214	42	0	30.2039	718	0.059697	243
	35	26.5048	—679	0.047579	—215		5	30.2757	—718	0.059939	—242
	40	26.5727	679	0.047794	215		10	30.3476	719	0.060183	244
	45	26.6407	680	0.048010	216		15	30.4196	720	0.060426	243
	50	26.7088	681	0.048226	216		20	30.4917	721	0.060671	245
	55	26.7770	682	0.048443	217		25	30.5639	722	0.060915	244
38	0	26.8452	682	0.048660	217		30	30.6361	722	0.061161	246
	5	26.9134	—682	0.048878	—218		35	30.7085	—724	0.061407	—246
	10	26.9818	684	0.049096	218		40	30.7809	724	0.061653	246
	15	27.0502	684	0.049315	219		45	30.8534	725	0.061900	247
	20	27.1187	685	0.049534	219		50	30.9259	725	0.062148	248
	25	27.1872	685	0.049754	220		55	30.9986	727	0.062396	248
	30	27.2559	687	0.049974	220	43	0	31.0713	727	0.062644	248
	35	27.3246	—687	0.050195	—221		5	31.1441	—728	0.062893	—249
	40	27.3933	687	0.050416	221		10	31.2170	729	0.063143	250
	45	27.4621	688	0.050638	222		15	31.2900	730	0.063393	250
	50	27.5310	689	0.050861	223		20	31.3631	731	0.063644	251
	55	27.6000	690	0.051083	222		25	31.4363	732	0.063895	251
39	0	27.6691	691	0.051307	224		30	31.5095	732	0.064147	252
	5	27.7382	—691	0.051531	—224		35	31.5829	—734	0.064399	—252
	10	27.8074	692	0.051755	224		40	31.6563	734	0.064652	253
	15	27.8766	692	0.051980	225		45	31.7298	735	0.064905	253
	20	27.9459	693	0.052206	226		50	31.8033	735	0.065159	254
	25	28.0153	694	0.052432	226		55	31.8770	737	0.065413	254
	30	28.0848	695	0.052658	226	44	0	31.9508	738	0.065668	255
	35	28.1544	—696	0.052885	—227		5	32.0246	—738	0.065924	—256
	40	28.2240	696	0.053113	228		10	32.0986	740	0.066180	256
	45	28.2937	697	0.053341	228		15	32.1726	740	0.066436	256
	50	28.3634	697	0.053570	229		20	32.2467	741	0.066693	257
	55	28.4333	699	0.053799	229		25	32.3209	742	0.066951	258
40	0	28.5032	699	0.054028	229		30	32.3952	743	0.067209	258
	5	28.5732	—700	0.054259	—231		35	32.4695	—743	0.067468	—259
	10	28.6432	700	0.054489	230		40	32.5440	745	0.067727	259
	15	28.7134	702	0.054720	231		45	32.6185	745	0.067987	260
	20	28.7836	702	0.054952	232		50	32.6932	747	0.068247	260
	25	28.8539	703	0.055184	232		55	32.7679	747	0.068508	261
	30	28.9242	703	0.055417	233	45	0	32.8427	748	0.068769	261
			—704		—233				—749		—262

N. B. Here the second column begins to be the Logarithm of the Mean Motion.

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
45	5	1.517428	−989	0.069031	−262
	10	1.518417	989	0.069294	263
	15	1.519404	987	0.069557	263
	20	1.520390	986	0.069820	263
	25	1.521376	986	0.070084	264
	30	1.522360	984	0.070349	265
	35	1.523343	−983	0.070614	−265
	40	1.524325	982	0.070880	266
	45	1.525306	981	0.071146	266
	50	1.526286	980	0.071413	267
	55	1.527265	979	0.071680	267
46	0	1.528243	978	0.071948	268
	5	1.529221	−978	0.072216	−268
	10	1.530197	976	0.072485	269
	15	1.531172	975	0.072755	270
	20	1.532146	974	0.073025	270
	25	1.533119	973	0.073295	270
	30	1.534091	972	0.073566	271
	35	1.535063	−972	0.073838	−272
	40	1.536033	970	0.074110	272
	45	1.537002	969	0.074383	273
	50	1.537971	969	0.074656	273
	55	1.538938	967	0.074930	274
47	0	1.539905	967	0.075204	274
	5	1.540870	−965	0.075479	−275
	10	1.541835	965	0.075755	276
	15	1.542799	964	0.076031	276
	20	1.543762	963	0.076307	276
	25	1.544724	962	0.076585	278
	30	1.545685	961	0.076862	277
	35	1.546645	−960	0.077140	−278
	40	1.547604	959	0.077419	279
	45	1.548563	959	0.077698	279
	50	1.549520	957	0.077978	280
	55	1.550477	957	0.078259	281
48	0	1.551433	956	0.078540	281
	5	1.552388	−955	0.078821	−281
	10	1.553342	954	0.079103	282
	15	1.554295	953	0.079386	283
	20	1.555247	952	0.079669	283
	25	1.556199	952	0.079953	284
	30	1.557149	950	0.080237	284
	35	1.558099	−950	0.080522	−285
	40	1.559048	949	0.080807	285
	45	1.559996	948	0.081093	286
	50	1.560944	948	0.081380	287
	55	1.561890	946	0.081667	287
49	0	1.562836	946	0.081954	287
	5	1.563781	−945	0.082242	−288
	10	1.564725	944	0.082531	289
	15	1.565668	943	0.082820	289
	20	1.566611	943	0.083110	290
	25	1.567553	942	0.083400	290
	30	1.568494	941	0.083691	291
			−940		−292

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
49	35	1.569434	−940	0.083983	−292
	40	1.570373	939	0.084275	292
	45	1.571312	939	0.084567	292
	50	1.572250	938	0.084861	294
	55	1.573187	937	0.085154	293
50	0	1.574123	936	0.085449	295
	5	1.575059	−936	0.085743	−294
	10	1.575994	935	0.086039	296
	15	1.576928	934	0.086335	296
	20	1.577862	934	0.086631	296
	25	1.578794	932	0.086928	297
	30	1.579726	932	0.087226	298
	35	1.580658	−932	0.087524	−298
	40	1.581588	930	0.087823	299
	45	1.582518	930	0.088122	299
	50	1.583447	929	0.088422	300
	55	1.584375	928	0.088723	301
51	0	1.585303	928	0.089024	301
	5	1.586230	−927	0.089325	−301
	10	1.587156	926	0.089627	302
	15	1.588082	926	0.089930	303
	20	1.589007	925	0.090233	303
	25	1.589931	924	0.090537	304
	30	1.590855	924	0.090841	304
	35	1.591778	−923	0.091146	−305
	40	1.592700	922	0.091452	306
	45	1.593622	922	0.091758	306
	50	1.594543	921	0.092065	307
	55	1.595463	920	0.092372	307
52	0	1.596383	920	0.092680	308
	5	1.597302	−919	0.092988	−308
	10	1.598220	918	0.093297	309
	15	1.599138	918	0.093606	309
	20	1.600055	917	0.093916	310
	25	1.600972	917	0.094227	311
	30	1.601888	916	0.094538	311
	35	1.602803	−915	0.094850	−312
	40	1.603718	915	0.095162	312
	45	1.604632	914	0.095475	313
	50	1.605545	913	0.095789	314
	55	1.606458	913	0.096103	314
53	0	1.607370	912	0.096418	315
	5	1.608282	−912	0.096733	−315
	10	1.609193	911	0.097049	316
	15	1.610104	911	0.097365	316
	20	1.611014	910	0.097682	317
	25	1.611923	909	0.098000	318
	30	1.612832	909	0.098318	318
	35	1.613740	−908	0.098636	−318
	40	1.614647	907	0.098955	319
	45	1.615554	907	0.099275	320
	50	1.616461	907	0.099596	321
	55	1.617367	906	0.099917	321
54	0	1.618272	905	0.100238	321
			−905		−322

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
54 5	1.619177	905	0.100560	322	58 35	1.667334	881	0.118827	354
10	1.620081	904	0.100883	323	40	1.668214	880	0.119182	355
15	1.620985	904	0.101206	323	45	1.669095	881	0.119537	355
20	1.621888	903	0.101530	324	50	1.669975	880	0.119893	356
25	1.622791	903	0.101855	325	55	1.670854	879	0.120249	356
30	1.623694	903	0.102180	325	59 0	1.671733	879	0.120606	357
35	1.624595	901	0.102505	325	5	1.672612	879	0.120964	358
40	1.625496	901	0.102832	327	10	1.673490	878	0.121322	358
45	1.626397	901	0.103158	326	15	1.674369	879	0.121681	359
50	1.627297	900	0.103486	328	20	1.675247	878	0.122041	360
55	1.628197	900	0.103814	328	25	1.676124	877	0.122401	360
55 0	1.629096	899	0.104142	328	30	1.677001	877	0.122762	361
5	1.629995	899	0.104471	329	35	1.677878	877	0.123123	361
10	1.630893	898	0.104801	330	40	1.678755	877	0.123485	362
15	1.631790	897	0.105131	330	45	1.679631	876	0.123847	362
20	1.632688	898	0.105462	331	50	1.680507	876	0.124211	364
25	1.633584	896	0.105794	332	55	1.681383	876	0.124574	363
3	1.63448c	896	0.106126	332	60 0	1.682258	875	0.124939	365
35	1.635376	896	0.106458	332	5	1.683133	875	0.125304	365
40	1.636271	895	0.106791	333	10	1.684008	875	0.125669	365
45	1.637166	895	0.107125	334	15	1.684883	875	0.126036	367
50	1.638060	894	0.107460	335	20	1.685757	874	0.126402	366
55	1.638954	894	0.107795	335	25	1.686631	874	0.126770	368
56 0	1.639848	894	0.108130	335	30	1.687504	873	0.127138	368
5	1.640740	892	0.108466	336	35	1.688378	874	0.127507	369
10	1.641633	893	0.108803	337	40	1.689251	873	0.127876	369
15	1.642525	892	0.109140	337	45	1.690124	873	0.128246	370
20	1.643417	892	0.109478	338	50	1.690997	873	0.128616	370
25	1.644308	891	0.109817	339	55	1.691869	872	0.128987	371
30	1.645199	891	0.110156	339	61 0	1.692741	872	0.129359	372
35	1.646089	890	0.110496	340	5	1.693613	872	0.129732	373
40	1.646978	889	0.110836	340	10	1.694484	871	0.130105	373
45	1.647868	890	0.111177	341	15	1.695355	871	0.130478	373
50	1.648757	889	0.111518	341	20	1.696226	871	0.130852	374
55	1.649645	888	0.111860	342	25	1.697097	871	0.131227	375
57 0	1.650534	889	0.112203	343	30	1.697968	871	0.131603	376
5	1.651421	887	0.112546	343	35	1.698838	870	0.131979	376
10	1.652309	888	0.112890	344	40	1.699708	870	0.132356	377
15	1.653196	887	0.113235	345	45	1.700578	870	0.132733	377
20	1.654082	886	0.113580	345	50	1.701448	870	0.133111	378
25	1.654968	886	0.113925	345	55	1.702317	869	0.133490	379
30	1.655854	886	0.114271	346	62 0	1.703186	869	0.133869	379
35	1.656739	885	0.114618	347	5	1.704055	869	0.134249	380
40	1.657624	885	0.114966	348	10	1.704924	869	0.134629	380
45	1.658509	885	0.115314	348	15	1.705793	869	0.135010	381
50	1.659393	884	0.115662	348	20	1.706661	868	0.135392	382
55	1.660277	884	0.116012	350	25	1.707529	868	0.135774	382
58 0	1.661160	883	0.116362	350	30	1.708397	868	0.136157	383
5	1.662043	883	0.116712	350	35	1.709265	868	0.136541	384
10	1.662926	883	0.117063	351	40	1.710133	868	0.136925	384
15	1.663808	882	0.117415	352	45	1.711000	867	0.137310	385
20	1.664690	882	0.117767	352	50	1.711867	867	0.137696	386
25	1.665572	882	0.118120	353	55	1.712734	867	0.138082	386
30	1.666453	881	0.118473	353	63 0	1.713601	867	0.138468	386
		881		354			866		388

A general Table of the Parabola.

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
			—866		—388				—861		—423
63	5	1.714467	867	0.138856	388	67	35	1.761067	861	0.160730	423
	10	1.715334	866	0.139244	389		40	1.761928	860	0.161153	423
	15	1.716200	866	0.139633	389		45	1.762788	861	0.161576	425
	20	1.717066	866	0.140022	390		50	1.763649	861	0.162001	425
	25	1.717932	865	0.140412	390		55	1.764510	861	0.162426	426
	30	1.718797	—866	0.140802	—391	68	0	1.765371	—860	0.162852	—426
	35	1.719663	865	0.141193	392		5	1.766231	861	0.163278	427
	40	1.720528	865	0.141585	393		10	1.767092	861	0.163705	428
	45	1.721393	865	0.141978	393		15	1.767953	860	0.164133	428
	50	1.722258	865	0.142371	394		20	1.768813	861	0.164561	429
	55	1.723123	865	0.142765	394		25	1.769674	861	0.164990	430
64	0	1.723988	—865	0.143159	—395		30	1.770535	—860	0.165420	—430
	5	1.724853	864	0.143554	396		35	1.771395	861	0.165850	431
	10	1.725717	864	0.143950	396		40	1.772256	860	0.166281	432
	15	1.726681	865	0.144346	397		45	1.773116	861	0.166713	433
	20	1.727446	864	0.144743	398		50	1.773977	861	0.167146	433
	25	1.728310	863	0.145141	398		55	1.774838	860	0.167579	434
	30	1.729173	—864	0.145539	—399	69	0	1.775698	—861	0.168013	—434
	35	1.730037	864	0.145938	399		5	1.776559	861	0.168447	435
	40	1.730901	863	0.146337	400		10	1.777420	861	0.168882	436
	45	1.731764	864	0.146737	401		15	1.778281	860	0.169318	436
	50	1.732628	863	0.147138	402		20	1.779141	861	0.169754	438
	55	1.733491	863	0.147540	402		25	1.780002	861	0.170192	438
65	0	1.734354	—863	0.147942	—402		30	1.780863	—861	0.170630	—438
	5	1.735217	863	0.148344	404		35	1.781724	860	0.171068	439
	10	1.736080	863	0.148748	404		40	1.782584	861	0.171507	440
	15	1.736943	862	0.149152	404		45	1.783445	861	0.171947	441
	20	1.737805	863	0.149556	406		50	1.784306	861	0.172388	441
	25	1.738668	862	0.149962	406		55	1.785167	861	0.172829	442
	30	1.739530	—863	0.150368	—406	70	0	1.786028	—861	0.173271	—443
	35	1.740393	862	0.150774	408		5	1.786889	862	0.173714	443
	40	1.741255	862	0.151182	408		10	1.787751	861	0.174157	444
	45	1.742117	862	0.151590	408		15	1.788612	861	0.174601	445
	50	1.742979	862	0.151998	409		20	1.789473	861	0.175046	445
	55	1.743841	862	0.152407	410		25	1.790334	861	0.175491	446
66	0	1.744703	—862	0.152817	—411		30	1.791195	—862	0.175937	—447
	5	1.745565	862	0.153228	411		35	1.792057	861	0.176384	447
	10	1.746427	861	0.153639	412		40	1.792918	862	0.176831	448
	15	1.747288	862	0.154051	412		45	1.793780	862	0.177279	449
	20	1.748150	862	0.154463	413		50	1.794642	861	0.177728	450
	25	1.749012	861	0.154876	414		55	1.795503	862	0.178178	450
	30	1.749873	—861	0.155290	—415	71	0	1.796365	—862	0.178628	—451
	35	1.750734	862	0.155705	415		5	1.797227	862	0.179079	451
	40	1.751596	861	0.156120	416		10	1.798089	862	0.179530	453
	45	1.752457	861	0.156536	416		15	1.798951	862	0.179983	453
	50	1.753318	861	0.156952	417		20	1.799813	862	0.180436	453
	55	1.754179	861	0.157369	418		25	1.800675	862	0.180889	455
67	0	1.755040	—862	0.157787	—418		30	1.801537	—863	0.181344	—455
	5	1.755902	861	0.158205	419		35	1.802400	862	0.181799	456
	10	1.756763	860	0.158624	420		40	1.803262	862	0.182255	456
	15	1.757623	861	0.159044	421		45	1.804124	863	0.182711	457
	20	1.758484	861	0.159465	421		50	1.804987	863	0.183168	458
	25	1.759345	861	0.159886	421		55	1.805850	863	0.183626	459
	30	1.760206	—861	0.160307	—423	72	0	1.806713	—863	0.184085	—459

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
72	5	1.807576	—863	0.184544	—459	76	35	1.854410	—873	0.210408	—498
	10	1.808439	863	0.185004	460		40	1.855283	873	0.210907	499
	15	1.809302	863	0.185465	461		45	1.856156	873	0.211407	500
	20	1.810165	863	0.185926	461		50	1.857029	873	0.211908	501
	25	1.811029	864	0.186388	462		55	1.857903	874	0.212409	501
	30	1.811892	863	0.186851	463	77	0	1.858777	874	0.212911	502
	35	1.812756	—864	0.187314	—463		5	1.859651	—874	0.213414	—503
	40	1.813620	864	0.187779	465		10	1.860526	875	0.213918	504
	45	1.814484	864	0.188244	465		15	1.861400	874	0.214422	504
	50	1.815348	864	0.188709	465		20	1.862275	875	0.214927	505
	55	1.816212	864	0.189176	467		25	1.863151	876	0.215433	506
73	0	1.817077	865	0.189643	467		30	1.864026	875	0.215939	506
	5	1.817941	—864	0.190110	—467		35	1.864902	—876	0.216447	—508
	10	1.818805	864	0.190579	469		40	1.865778	876	0.216955	508
	15	1.819670	865	0.191048	469		45	1.866655	877	0.217464	509
	20	1.820535	865	0.191518	470		50	1.867532	877	0.217973	509
	25	1.821400	865	0.191988	470		55	1.868408	876	0.218484	511
	30	1.822266	866	0.192460	472	78	0	1.869286	878	0.218995	511
	35	1.823131	—865	0.192932	—472		5	1.870163	—877	0.219507	—512
	40	1.823997	866	0.193405	473		10	1.871041	878	0.220019	512
	45	1.824862	865	0.193878	473		15	1.871919	878	0.220533	514
	50	1.825728	866	0.194352	474		20	1.872798	879	0.221047	514
	55	1.826594	866	0.194827	475		25	1.873677	879	0.221562	515
74	0	1.827460	866	0.195303	476		30	1.874556	879	0.222078	516
	5	1.828327	—867	0.195779	—476		35	1.875435	—879	0.222594	—516
	10	1.829193	866	0.196256	477		40	1.876315	880	0.223111	517
	15	1.830060	867	0.196734	478		45	1.877195	880	0.223629	518
	20	1.830927	867	0.197213	479		50	1.878075	880	0.224148	519
	25	1.831794	867	0.197692	479		55	1.878956	881	0.224668	520
	30	1.832661	867	0.198172	480	79	0	1.879837	881	0.225188	520
	35	1.833529	—868	0.198652	—480		5	1.880718	—881	0.225709	—521
	40	1.834396	867	0.199134	482		10	1.881600	882	0.226231	522
	45	1.835264	868	0.199616	482		15	1.882482	882	0.226753	522
	50	1.836132	868	0.200099	483		20	1.883364	882	0.227277	524
	55	1.837000	868	0.200582	483		25	1.884247	883	0.227801	524
75	0	1.837869	869	0.201067	485		30	1.885130	883	0.228326	525
	5	1.838737	—868	0.201552	—485		35	1.886013	—883	0.228852	—526
	10	1.839606	869	0.202038	486		40	1.886897	884	0.229378	526
	15	1.840475	869	0.202524	486		45	1.887781	884	0.229906	528
	20	1.841344	869	0.203011	487		50	1.888665	884	0.230434	528
	25	1.842214	870	0.203499	488		55	1.889550	885	0.230962	528
	30	1.843083	869	0.203988	489	80	0	1.890435	885	0.231492	530
	35	1.843953	—870	0.204477	—489		5	1.891320	—885	0.232022	—530
	40	1.844823	870	0.204968	491		10	1.892206	886	0.232554	532
	45	1.845694	871	0.205459	491		15	1.893092	886	0.233086	532
	50	1.846564	870	0.205950	491		20	1.893979	887	0.233618	532
	55	1.847435	871	0.206443	493		25	1.894866	887	0.234152	534
76	0	1.848306	871	0.206936	493		30	1.895753	887	0.234686	534
	5	1.849177	—871	0.207430	—494		35	1.896640	—887	0.235221	—535
	10	1.850049	872	0.207924	494		40	1.897528	888	0.235757	536
	15	1.850920	871	0.208420	496		45	1.898417	889	0.236294	537
	20	1.851792	872	0.208916	496		50	1.899305	888	0.236832	538
	25	1.852664	872	0.209412	496		55	1.900194	889	0.237370	538
	30	1.853537	873	0.209910	498	81	0	1.901084	890	0.237909	539
			—873		—498				—890		—540

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
			—890		—540				—915		—585
81	5	1.901974	890	0.238449	541	85	35	1.950678	915	0.268811	585
	10	1.902864	891	0.238990	541		40	1.951593	916	0.269396	586
	15	1.903755	891	0.239531	542		45	1.952509	917	0.269982	587
	20	1.904646	891	0.240073	543		50	1.953426	917	0.270569	587
	25	1.905537	892	0.240616	544		55	1.954343	917	0.271156	589
	30	1.906429	—892	0.241160	—545	86	0	1.955260	—918	0.271745	—590
	35	1.907321	893	0.241705	545		5	1.956178	919	0.272335	590
	40	1.908214	893	0.242250	547		10	1.957097	919	0.272925	591
	45	1.909107	894	0.242797	547		15	1.958016	920	0.273516	592
	50	1.910001	894	0.243344	548		20	1.958936	920	0.274108	593
	55	1.910895	894	0.243892	548		25	1.959856	921	0.274701	594
82	0	1.911789	—895	0.244440	—550		30	1.960777	—921	0.275295	—594
	5	1.912684	895	0.244990	550		35	1.961698	922	0.275889	596
	10	1.913579	896	0.245540	551		40	1.962620	923	0.276485	596
	15	1.914475	896	0 246091	552		45	1.963543	923	0.277081	597
	20	1.915371	896	0.246643	553		50	1.964466	924	0.277678	599
	25	1.916267	897	0.247196	553		55	1.965390	924	0.278277	599
	30	1.917164	—897	0.247749	—555	87	0	1.966314	—925	0.278876	—599
	35	1.918061	898	0.248304	555		5	1.967239	925	0.279475	601
	40	1.918959	898	0.248859	556		10	1.968164	926	0.280076	602
	45	1.919857	899	0.249415	557		15	1.969090	927	0.280678	602
	50	1.920756	899	0.249972	557		20	1.970017	927	0.281280	604
	55	1.921655	900	0.250529	559		25	1.970944	928	0.281884	604
83	0	1.922555	—900	0.251088	—559		30	1.971872	—929	0.282488	—605
	5	1.923455	900	0.251647	560		35	1.972801	929	0.283093	606
	10	1.924355	901	0.252207	561		40	1.973730	929	0.283699	607
	15	1.925256	901	0.252768	562		45	1.974659	930	0.284306	608
	20	1.926157	902	0.253330	562		50	1.975589	931	0.284914	608
	25	1.927059	903	0.253892	564		55	1.976520	932	0.285522	610
	30	1.927962	—903	0.254456	—564	88	0	1.977452	—932	0.286132	—610
	35	1.928865	903	0.255020	565		5	1.978384	933	0.286742	612
	40	1.929768	903	0.255585	566		10	1.979317	933	0.287354	612
	45	1.930671	904	0.256151	566		15	1.980250	934	0.287966	613
	50	1.931575	905	0.256717	568		20	1.981184	935	0.288579	614
	55	1.932480	905	0.257285	568		25	1.982119	935	0.289193	615
84	0	1.933385	—906	0.257853	—569		30	1.983054	—936	0.289808	—616
	5	1.934291	906	0.258422	570		35	1.983990	936	0.290424	616
	10	1.935197	907	0.258992	571		40	1.984926	938	0.291040	618
	15	1.936104	907	0.259563	572		45	1.985864	937	0.291658	618
	20	1.937011	907	0.260135	572		50	1.986801	939	0.292276	620
	25	1.937918	908	0.260707	574		55	1.987740	939	0.292896	620
	30	1.938826	—909	0 261281	—574	89	0	1.988679	—940	0.293516	—621
	35	1.939735	909	0.261855	575		5	1.989619	940	0.294137	622
	40	1.940644	910	0.262430	576		10	1.990559	941	0.294759	623
	45	1.941554	910	0.263006	576		15	1.991500	942	0.295382	624
	50	1.942464	910	0.263582	578		20	1.992442	942	0.296006	625
	55	1.943374	911	0.264160	578		25	1.993384	943	0.296631	626
85	0	1.944285	—912	0.264738	—579		30	1.994327	—944	0.297257	—626
	5	1.945197	912	0.265317	580		35	1.995271	945	0.297883	628
	10	1.946109	913	0.265897	581		40	1.996216	945	0.298511	628
	15	1.947022	913	0.266478	582		45	1.997161	946	0 299139	630
	20	1.947935	914	0.267060	583		50	1 998107	946	0.299769	630
	25	1.948849	914	0.267643	583		55	1.999053	947	0.300399	631
	30	1.949763	—915	0.268226	—585	90	0	2.000000	—948	0.301030	—632

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
90	5	2.000948	—948	0.301662	—632	94	35	2.053239	—989	0.337199	—684
	10	2.001897	949	0.302295	633		40	2.054230	991	0.337884	685
	15	2.002846	949	0.302929	634		45	2.055221	991	0.338570	686
	20	2.003796	950	0.303564	635		50	2.056213	992	0.339257	687
	25	2.004746	950	0.304200	636		55	2.057206	993	0.339944	687
	30	2.005697	951	0.304837	637	95	0	2.058200	994	0.340633	689
	35	2.006649	—952	0.305474	—637		5	2.059195	—995	0.341323	—690
	40	2.007602	953	0.306113	639		10	2.060191	996	0.342014	691
	45	2.008556	954	0.306752	639		15	2.061188	997	0.342706	692
	50	2.009510	954	0.307393	641		20	2.062185	997	0.343399	693
	55	2.010465	955	0.308034	641		25	2.063184	999	0.344093	694
91	0	2.011420	955	0.308676	642		30	2.064183	999	0.344787	694
	5	2.012377	—957	0.309320	—644		35	2.065183	—1000	0.345483	—696
	10	2.013334	957	0.309964	644		40	2.066184	1001	0.346180	697
	15	2.014292	958	0.310609	645		45	2.067186	1002	0.346878	698
	20	2.015250	958	0.311255	646		50	2.068189	1003	0.347577	699
	25	2.016209	959	0.311902	647		55	2.069193	1004	0.348277	700
	30	2.017169	960	0.312550	648	96	0	2.070198	1005	0.348978	701
	35	2.018130	—961	0.313199	—649		5	2.071204	—1006	0.349680	—702
	40	2.019091	961	0.313849	650		10	2.072211	1007	0.350383	703
	45	2.020054	963	0.314499	650		15	2.073218	1007	0.351087	704
	50	2.021017	963	0.315151	652		20	2.074226	1008	0.351793	706
	55	2.021981	964	0.315804	653		25	2.075236	1010	0.352499	706
92	0	2.022945	964	0.316457	653		30	2.076246	1010	0.353206	707
	5	2.023910	—965	0.317112	—655		35	2.077257	—1011	0.353914	—708
	10	2.024876	966	0.317768	656		40	2.078270	1013	0.354623	709
	15	2.025843	967	0.318424	656		45	2.079283	1013	0.355334	711
	20	2.026811	968	0.319081	657		50	2.080297	1014	0.356045	711
	25	2.027779	968	0.319740	659		55	2.081312	1015	0.356757	712
	30	2.028748	969	0.320399	659	97	0	2.082328	1016	0.357471	714
	35	2.029718	—970	0.321060	—661		5	2.083345	—1017	0.358185	—714
	40	2.030689	971	0.321721	661		10	2.084363	1018	0.358901	716
	45	2.031660	971	0.322383	662		15	2.085382	1019	0.359617	716
	50	2.032633	973	0.323046	663		20	2.086402	1020	0.360335	718
	55	2.033606	973	0.323710	664		25	2.087423	1021	0.361054	719
93	0	2.034580	974	0.324376	666		30	2.088445	1022	0.361773	719
	5	2.035554	—974	0.325042	—666		35	2.089468	—1023	0.362494	—721
	10	2.036530	976	0.325709	667		40	2.090492	1024	0.363216	722
	15	2.037506	976	0.326377	668		45	2.091517	1025	0.363939	723
	20	2.038483	977	0.327046	669		50	2.092542	1025	0.364663	724
	25	2.039461	978	0.327716	670		55	2.093569	1027	0.365388	725
	30	2.040440	979	0.328387	671	98	0	2.094597	1028	0.366114	726
	35	2.041419	—979	0.329059	—672		5	2.095626	—1029	0.366841	—727
	40	2.042400	981	0.329732	673		10	2.096656	1030	0.367570	729
	45	2.043381	981	0.330406	674		15	2.097687	1031	0.368299	729
	50	2.044363	982	0.331081	675		20	2.098719	1032	0.369029	730
	55	2.045346	983	0.331757	676		25	2.099752	1033	0.369761	732
94	0	2.046330	984	0.332433	676		30	2.100785	1033	0.370493	732
	5	2.047314	—984	0.333111	—678		35	2.101820	—1035	0.371227	—734
	10	2.048299	985	0.333790	679		40	2.102856	1036	0.371962	735
	15	2.049286	987	0.334470	680		45	2.103893	1037	0.372697	735
	20	2.050273	987	0.335151	681		50	2.104931	1038	0.373434	737
	25	2.051261	988	0.335833	682		55	2.105971	1040	0.374172	738
	30	2.052250	989	0.336515	682	99	0	2.107011	1040	0.374911	739
			—989		—684				—1041		—740

Angle.		Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.		Log. Mean Mot.	Diff.	Log. Dist.	Diff.
°	′					°	′				
99	5	2.108052	—1041	0.375651	—740	103	35	2.165946	—1104	0.417289	—802
	10	2.109094	1042	0.376392	741		40	2.167051	1105	0.418092	803
	15	2.110138	1044	0.377135	743		45	2.168158	1107	0.418896	804
	20	2.111182	1044	0.377878	743		50	2.169265	1107	0.419701	805
	25	2.112227	1045	0.378623	745		55	2.170374	1109	0.420508	807
	30	2.113274	1047	0.379368	745	104	0	2.171484	1110	0.421316	808
	35	2.114322	—1048	0.380115	—747		5	2.172596	—1112	0.422125	—809
	40	2.115370	1048	0.380863	748		10	2.173709	1113	0.422935	810
	45	2.116420	1050	0.381612	749		15	2.174823	1114	0.423747	812
	50	2.117471	1051	0.382362	750		20	2.175938	1115	0.424560	813
	55	2.118523	1052	0.383113	751		25	2.177055	1117	0.425374	814
100	0	2.119576	1053	0.383865	752		30	2.178173	1118	0.426189	815
	5	2.120630	—1054	0.384618	—753		35	2.179292	—1119	0.427005	—816
	10	2.121685	1055	0.385373	755		40	2.180413	1121	0.427823	818
	15	2.122742	1057	0.386128	755		45	2.181535	1122	0.428642	819
	20	2.123799	1057	0.386885	757		50	2.182658	1123	0.429462	820
	25	2.124857	1058	0.387643	758		55	2.183783	1125	0.430283	821
	30	2.125917	1060	0.388402	759	105	0	2.184909	1126	0.431106	823
	35	2.126978	—1061	0.389162	—760		5	2.186036	—1127	0.431930	—824
	40	2.128040	1062	0.389923	761		10	2.187165	1129	0.432755	825
	45	2.129103	1063	0.390685	762		15	2.188295	1130	0.433581	826
	50	2.130167	1064	0.391449	764		20	2.189427	1132	0.434408	827
	55	2.131232	1065	0.392213	764		25	2.190560	1133	0.435237	829
101	0	2.132299	1067	0.392979	766		30	2.191694	1134	0.436067	830
	5	2.133367	—1068	0.393746	—767		35	2.192830	—1136	0.436899	—832
	10	2.134435	1068	0.394514	768		40	2.193967	1137	0.437731	832
	15	2.135505	1070	0.395283	769		45	2.195105	1138	0.438565	834
	20	2.136576	1071	0.396053	770		50	2.196245	1140	0.439400	835
	25	2.137648	1072	0.396824	771		55	2.197386	1141	0.440236	836
	30	2.138722	1074	0.397597	773	106	0	2.198528	1142	0.441074	838
	35	2.139796	—1074	0.398371	—774		5	2.199672	—1144	0.441913	—839
	40	2.140872	1076	0.399146	775		10	2.200817	1145	0.442753	840
	45	2.141949	1077	0.399922	776		15	2.201964	1147	0.443594	841
	50	2.143027	1078	0.400699	777		20	2.203112	1148	0.444437	843
	55	2.144106	1079	0.401477	778		25	2.204262	1150	0.445281	844
102	0	2.145187	1081	0.402256	779		30	2.205413	1151	0.446126	845
	5	2.146268	—1081	0.403037	—781		35	2.206565	—1152	0.446973	—847
	10	2.147351	1083	0.403819	782		40	2.207719	1154	0.447821	848
	15	2.148435	1084	0.404602	783		45	2.208875	1156	0.448670	849
	20	2.149520	1085	0.405386	784		50	2.210031	1156	0.449520	850
	25	2.150607	1087	0.406171	785		55	2.211189	1158	0.450372	852
	30	2.151695	1088	0.406957	786	107	0	2.212349	1160	0.451225	853
	35	2.152783	—1088	0.407745	—788		5	2.213510	—1161	0.452079	—854
	40	2.153873	1090	0.408534	789		10	2.214673	1163	0.452935	856
	45	2.154965	1092	0.409324	790		15	2.215837	1164	0.453792	857
	50	2.156057	1092	0.410115	791		20	2.217003	1166	0.454650	858
	55	2.157151	1094	0.410907	792		25	2.218170	1167	0.455509	859
103	0	2.158246	1095	0.411701	794		30	2.219338	1168	0.456370	861
	5	2.159342	—1096	0.412490	—795		35	2.220508	—1170	0.457232	—862
	10	2.160440	1098	0.413292	796		40	2.221680	1172	0.458096	864
	15	2.161539	1099	0.414089	797		45	2.222853	1173	0.458960	864
	20	2.162639	1100	0.414887	798		50	2.224027	1174	0.459826	866
	25	2.163740	1101	0.415686	799		55	2.225203	1176	0.460694	868
	30	2.164842	1102	0.416487	801	108	0	2.226381	1178	0.461563	869
			—1104		—802				—1170		870

Angle.	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
° ′					° ′				
108 5	2.227560	1179	0.462433	870	112 35	2.293634	1270	0.511468	946
10	2.228740	1180	0.463304	871	40	2.294905	1271	0.512416	948
15	2.229922	1182	0.464177	873	45	2.296177	1272	0.513365	949
20	2.231106	1184	0.465051	874	50	2.297452	1275	0.514315	950
25	2.232291	1185	0.465926	875	55	2.298728	1276	0.515267	952
30	2.233478	1187	0.466803	877	113 0	2.300007	1279	0.516221	954
35	2.234666	1188	0.467681	878	5	2.301287	1280	0.517176	955
40	2.235856	1190	0.468561	880	10	2.302569	1282	0.518133	957
45	2.237048	1192	0.469441	880	15	2.303853	1284	0.519091	958
50	2.238241	1193	0.470324	883	20	2.305139	1286	0.520050	959
55	2.239435	1194	0.471207	883	25	2.306426	1287	0.521012	962
109 0	2.240631	1196	0.472092	885	30	2.307716	1290	0.521974	962
5	2.241829	1198	0.472978	886	35	2.309007	1291	0.522938	964
10	2.243028	1199	0.473866	888	40	2.310300	1293	0.523904	966
15	2.244229	1201	0.474755	889	45	2.311596	1296	0.524871	967
20	2.245432	1203	0.475645	890	50	2.312893	1297	0.525840	969
25	2.246636	1204	0.476537	892	55	2.314192	1299	0.526811	971
30	2.247842	1206	0.477430	893	114 0	2.315493	1301	0.527782	971
35	2.249049	1207	0.478324	894	5	2.316796	1303	0.528756	974
40	2.250258	1209	0.479220	896	10	2.318101	1305	0.529731	975
45	2.251468	1210	0.480117	897	15	2.319407	1306	0.530707	976
50	2.252680	1212	0.481016	899	20	2.320716	1309	0.531686	979
55	2.253894	1214	0.481916	900	25	2.322027	1311	0.532665	979
110 0	2.255110	1216	0.482817	901	30	2.323339	1312	0.533646	981
5	2.256327	1217	0.483720	903	35	2.324654	1315	0.534629	983
10	2.257546	1219	0.484624	904	40	2.325970	1316	0.535614	985
15	2.258766	1220	0.485530	906	45	2.327289	1319	0.536600	986
20	2.259988	1222	0.486437	907	50	2.328609	1320	0.537587	987
25	2.261212	1224	0.487345	908	55	2.329932	1323	0.538576	989
30	2.262437	1225	0.488255	910	115 0	2.331257	1325	0.539567	991
35	2.263664	1227	0.489166	911	5	2.332583	1326	0.540559	992
40	2.264893	1229	0.490079	913	10	2.333912	1329	0.541553	994
45	2.266124	1231	0.490993	914	15	2.335242	1330	0.542549	996
50	2.267356	1232	0.491909	916	20	2.336575	1333	0.543546	997
55	2.268590	1234	0.492826	917	25	2.337909	1334	0.544545	999
111 0	2.269826	1236	0.493744	918	30	2.339246	1337	0.545545	1000
5	2.271063	1237	0.494664	920	35	2.340585	1339	0.546547	1002
10	2.272302	1239	0.495585	921	40	2.341925	1340	0.547550	1003
15	2.273543	1241	0.496508	923	45	2.343268	1343	0.548555	1005
20	2.274785	1242	0.497432	924	50	2.344613	1345	0.549562	1007
25	2.276029	1244	0.498357	925	55	2.345960	1347	0.550571	1009
30	2.277275	1246	0.499284	927	116 0	2.347309	1349	0.551581	1010
35	2.278523	1248	0.500213	929	5	2.348660	1351	0.552592	1011
40	2.279772	1249	0.501143	930	10	2.350014	1354	0.553606	1014
45	2.281023	1251	0.502074	931	15	2.351369	1355	0.554621	1015
50	2.282276	1253	0.503007	933	20	2.352726	1357	0.555637	1016
55	2.283531	1255	0.503941	934	25	2.354086	1360	0.556655	1018
112 0	2.284788	1257	0.504877	936	30	2.355448	1362	0.557675	1020
5	2.286046	1258	0.505814	937	35	2.356812	1364	0.558697	1022
10	2.287306	1260	0.506753	939	40	2.358177	1365	0.559720	1023
15	2.288568	1262	0.507693	940	45	2.359545	1368	0.560745	1025
20	2.289832	1264	0.508634	941	50	2.360916	1371	0.561772	1027
25	2.291097	1265	0.509577	943	55	2.362288	1372	0.562800	1028
30	2.292364	1267	0.510522	945	117 0	2.363663	1375	0.563830	1030
		1270		946			1377		1032

Angle.	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
° ′					° ′				
117 5	2.365040	—1377	0.564862	—1032	121 35	2.442820	—1506	0.623184	—1129
10	2.366418	1378	0.565895	1033	40	2.444328	1508	0.624315	1131
15	2.367799	1381	0.566930	1035	45	2.445839	1511	0.625448	1133
20	2.369183	1384	0.567966	1036	50	2.447352	1513	0.626582	1134
25	2.370568	1385	0.569005	1039	55	2.448868	1516	0.627719	1137
30	2.371956	1388	0.570045	1040	122 0	2.450387	1519	0.628858	1139
35	2.373346	—1390	0.571087	—1042	5	2.451908	—1521	0.629998	—1140
40	2.374738	1392	0.572130	1043	10	2.453432	1524	0.631141	1143
45	2.376132	1394	0.573175	1045	15	2.454959	1527	0.632285	1144
50	2.377529	1397	0.574222	1047	20	2.456488	1529	0.633431	1146
55	2.378928	1399	0.575271	1049	25	2.458020	1532	0.634580	1149
118 0	2.380329	1401	0.576321	1050	30	2.459555	1535	0.635730	1150
5	2.381732	—1403	0.577373	—1052	35	2.461092	—1537	0.636882	—1152
10	2.383138	1406	0.578427	1054	40	2.462632	1540	0.638037	1155
15	2.384546	1408	0.579483	1056	45	2.464175	1543	0.639193	1156
20	2.385956	1410	0.580540	1057	50	2.465721	1546	0.640351	1158
25	2.387369	1413	0.581599	1059	55	2.467269	1548	0.641512	1161
30	2.388784	1415	0.582660	1061	123 0	2.468821	1552	0.642674	1162
35	2.390201	—1417	0.583723	—1063	5	2.470375	—1554	0.643839	—1165
40	2.391620	1419	0.584787	1064	10	2.471931	1556	0.645005	1166
45	2.393042	1422	0.585853	1066	15	2.473491	1560	0.646173	1168
50	2.394466	1424	0.586921	1068	20	2.475053	1562	0.647344	1171
55	2.395892	1426	0.587991	1070	25	2.476618	1565	0.648516	1172
119 0	2.397321	1429	0.589062	1071	30	2.478186	1568	0.649691	1175
5	2.398752	—1431	0.590136	—1074	35	2.479756	—1570	0.650867	—1176
10	2.400186	1434	0.591211	1075	40	2.481330	1574	0.652046	1179
15	2.401622	1436	0.592287	1076	45	2.482907	1577	0.653227	1181
20	2.403060	1438	0.593366	1079	50	2.484486	1579	0.654410	1183
25	2.404500	1440	0.594446	1080	55	2.486068	1582	0.655594	1184
30	2.405943	1443	0.595529	1083	124 0	2.487653	1585	0.656781	1187
35	2.407389	—1446	0.596613	—1084	5	2.489241	—1588	0.657970	—1189
40	2.408836	1447	0.597698	1085	10	2.490832	1591	0.659162	1192
45	2.410287	1451	0.598786	1088	15	2.492425	1593	0.660355	1193
50	2.411739	1452	0.599876	1090	20	2.494022	1597	0.661550	1195
55	2.413194	1455	0.600967	1091	25	2.495621	1599	0.662747	1197
120 0	2.414652	1458	0.602060	1093	30	2.497224	1603	0.663947	1200
5	2.416112	—1460	0.603155	—1095	35	2.498829	—1605	0.665149	—1202
10	2.417574	1462	0.604252	1097	40	2.500437	1608	0.666352	1203
15	2.419039	1465	0.605350	1098	45	2.502049	1612	0.667558	1206
20	2.420507	1468	0.606451	1101	50	2.503663	1614	0.668766	1208
25	2.421977	1470	0.607553	1102	55	2.505280	1617	0.669977	1211
30	2.423449	1472	0.608658	1105	125 0	2.506901	1621	0.671189	1212
35	2.424924	—1475	0.609764	—1106	5	2.508524	—1623	0.672403	—1214
40	2.426401	1477	0.610872	1108	10	2.510150	1626	0.673620	1217
45	2.427881	1480	0.611982	1110	15	2.511780	1630	0.674839	1219
50	2.429363	1482	0.613093	1111	20	2.513412	1632	0.676060	1221
55	2.430848	1485	0.614207	1114	25	2.515047	1635	0.677283	1223
121 0	2.432336	1488	0.615322	1115	30	2.516686	1639	0.678508	1225
5	2.433826	—1490	0.616440	—1118	35	2.518327	—1641	0.679736	—1228
10	2.435318	1492	0.617559	1119	40	2.519972	1645	0.680965	1229
15	2.436813	1495	0.618680	1121	45	2.521620	1648	0.682197	1232
20	2.438311	1498	0.619803	1123	50	2.523270	1650	0.683432	1235
25	2.439811	1500	0.620928	1125	55	2.524924	1654	0.684668	1236
30	2.441314	1503	0.622055	1127	126 0	2.526581	1657	0.685906	1238
		—1506		—1129			—1660		—1241

Angle.	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
° ′					° ′				
126 5	2.528241	—1660	0.687147	—1241	130 35	2.622869	—1847	0.757649	—1371
10	2.529905	1664	0.688390	1243	40	2.624720	1851	0.759023	1374
15	2.531571	1666	0.689636	1246	45	2.626575	1855	0.760400	1377
20	2.533241	1670	0.690883	1247	50	2.628434	1859	0.761779	1379
25	2.534914	1673	0.692133	1250	55	2.630296	1862	0.763161	1382
30	2.536590	1676	0.693385	1252	131 0	2.632162	1866	0.764546	1385
35	2.538269	—1679	0.694639	—1254	5	2.634032	—1870	0.765933	—1387
40	2.539951	1682	0.695896	1257	10	2.635907	1875	0.767324	1391
45	2.541637	1686	0.697155	1259	15	2.637785	1878	0.768716	1392
50	2.543326	1689	0.698416	1261	20	2.639667	1882	0.770112	1396
55	2.545018	1692	0.699679	1263	25	2.641553	1886	0.771510	1398
127 0	2.546714	1696	0.700945	1266	30	2.643443	1890	0.772911	1401
5	2.548412	—1698	0.702213	—1268	35	2.645336	—1893	0.774314	—1403
10	2.550114	1702	0.703484	1271	40	2.647234	1898	0.775721	1407
15	2.551819	1705	0.704756	1272	45	2.649136	1902	0.777130	1409
20	2.553528	1709	0.706031	1275	50	2.651042	1906	0.778541	1411
25	2.555240	1712	0.707309	1278	55	2.652952	1910	0.779956	1415
30	2.556955	1715	0.708588	1279	132 0	2.654866	1914	0.781373	1417
35	2.558674	—1719	0.709870	—1282	5	2.656784	—1918	0.782794	—1421
40	2.560395	1721	0.711155	1285	10	2.658706	1922	0.784217	1423
45	2.562121	1726	0.712442	1287	15	2.660632	1926	0.785642	1425
50	2.563849	1728	0.713731	1289	20	2.662562	1930	0.787071	1429
55	2.565581	1732	0.715022	1291	25	2.664497	1935	0.788502	1431
128 0	2.567316	1735	0.716316	1294	30	2.666435	1938	0.789936	1434
5	2.569055	—1739	0.717612	—1296	35	2.668378	—1943	0.791373	—1437
10	2.570798	1743	0.718911	1299	40	2.670325	1947	0.792813	1440
15	2.572544	1746	0.720212	1301	45	2.672276	1951	0.794255	1442
20	2.574293	1749	0.721516	1304	50	2.674231	1955	0.795701	1446
25	2.576045	1752	0.722822	1306	55	2.676191	1960	0.797149	1448
30	2.577801	1756	0.724130	1308	133 0	2.678155	1964	0.798601	1452
35	2.579561	—1760	0.725441	—1311	5	2.680123	—1968	0.800055	—1454
40	2.581324	1763	0.726754	1313	10	2.682095	1972	0.801512	1457
45	2.583090	1766	0.728070	1316	15	2.684071	1976	0.802972	1460
50	2.584860	1770	0.729388	1318	20	2.686052	1981	0.804435	1463
55	2.586634	1774	0.730708	1320	25	2.688037	1985	0.805900	1465
129 0	2.588411	1777	0.732031	1323	30	2.690027	1990	0.807369	1469
5	2.590192	—1781	0.733357	—1326	35	2.692021	—1994	0.808841	—1472
10	2.591976	1784	0.734685	1328	40	2.694019	1998	0.810316	1475
15	2.593764	1788	0.736015	1330	45	2.696022	2003	0.811793	1477
20	2.595556	1792	0.737348	1333	50	2.698029	2007	0.813274	1481
25	2.597351	1795	0.738684	1336	55	2.700040	2011	0.814757	1483
30	2.599150	1799	0.740022	1338	134 0	2.702056	2016	0.816244	1487
35	2.600952	—1802	0.741363	—1341	5	2.704077	—2021	0.817734	—1490
40	2.602758	1806	0.742706	1343	10	2.706101	2024	0.819226	1492
45	2.604568	1810	0.744051	1345	15	2.708131	2030	0.820722	1496
50	2.606381	1813	0.745399	1348	20	2.710165	2034	0.822221	1499
55	2.608198	1817	0.746750	1351	25	2.712203	2038	0.823722	1501
130 0	2.610019	1821	0.748103	1353	30	2.714246	2043	0.825227	1505
5	2.611843	—1824	0.749459	—1356	35	2.716293	—2047	0.826735	—1508
10	2.613671	1828	0.750818	1359	40	2.718345	2052	0.828246	1511
15	2.615503	1832	0.752179	1361	45	2.720401	2056	0.829760	1514
20	2.617339	1836	0.753543	1364	50	2.722463	2062	0.831277	1517
25	2.619179	1840	0.754909	1366	55	2.724528	2065	0.832797	1520
30	2.621022	1843	0.756278	1369	135 0	2.726599	2071	0.834321	1524
		—1847		—1371			—2075		—1526

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
135	5	2.728674	2075	0.835847	1526
	10	2.730754	2080	0.837377	1530
	15	2.732838	2084	0.838910	1533
	20	2.734927	2089	0.840446	1536
	25	2.737021	2094	0.841985	1539
	30	2.739120	2099	0.843527	1542
	35	2.741224	2104	0.845073	1546
	40	2.743332	2108	0.846622	1549
	45	2.745445	2113	0.848174	1552
	50	2.747563	2118	0.849729	1555
	55	2.749686	2123	0.851287	1558
136	0	2.751814	2128	0.852849	1562
	5	2.753946	2132	0.854414	1565
	10	2.756084	2138	0.855983	1569
	15	2.758226	2142	0.857554	1571
	20	2.760373	2147	0.859129	1575
	25	2.762526	2153	0.860707	1578
	30	2.764683	2157	0.862289	1582
	35	2.766845	2162	0.863874	1585
	40	2.769012	2167	0.865462	1588
	45	2.771185	2173	0.867054	1592
	50	2.773362	2177	0.868649	1595
	55	2.775544	2182	0.870247	1598
137	0	2.777732	2188	0.871849	1602
	5	2.779925	2193	0.873454	1605
	10	2.782123	2198	0.875063	1609
	15	2.784326	2203	0.876675	1612
	20	2.786534	2208	0.878291	1616
	25	2.788748	2214	0.879910	1619
	30	2.790966	2218	0.881533	1623
	35	2.793190	2224	0.883159	1626
	40	2.795419	2229	0.884788	1629
	45	2.797654	2235	0.886421	1633
	50	2.799894	2240	0.888058	1637
	55	2.802139	2245	0.889698	1640
138	0	2.804389	2250	0.891342	1644
	5	2.806645	2256	0.892989	1647
	10	2.808907	2262	0.894640	1651
	15	2.811174	2267	0.896294	1654
	20	2.813446	2272	0.897953	1659
	25	2.815723	2277	0.899614	1661
	30	2.818006	2283	0.901280	1666
	35	2.820295	2289	0.902949	1669
	40	2.822589	2294	0.904621	1672
	45	2.824889	2300	0.906298	1677
	50	2.827195	2306	0.907978	1680
	55	2.829506	2311	0.909662	1684
139	0	2.831822	2316	0.911349	1687
	5	2.834145	2323	0.913041	1692
	10	2.836473	2328	0.914736	1695
	15	2.838806	2333	0.916435	1699
	20	2.841146	2340	0.918137	1702
	25	2.843491	2345	0.919844	1707
	30	2.845842	2351	0.921554	1710
			2357		1714

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
139	35	2.848199	2357	0.923268	1714
	40	2.850561	2362	0.924986	1718
	45	2.852930	2369	0.926708	1722
	50	2.855304	2374	0.928434	1726
	55	2.857684	2380	0.930163	1729
140	0	2.860070	2386	0.931897	1734
	5	2.862462	2392	0.933634	1737
	10	2.864860	2398	0.935375	1741
	15	2.867265	2405	0.937121	1746
	20	2.869675	2410	0.938870	1749
	25	2.872091	2416	0.940623	1753
	30	2.874513	2422	0.942381	1758
	35	2.876941	2428	0.944142	1761
	40	2.879376	2435	0.945907	1765
	45	2.881816	2440	0.947677	1770
	50	2.884263	2447	0.949450	1773
	55	2.886716	2453	0.951228	1778
141	0	2.889175	2459	0.953009	1781
	5	2.891641	2466	0.954795	1786
	10	2.894113	2472	0.956585	1790
	15	2.896591	2478	0.958379	1794
	20	2.899075	2484	0.960178	1799
	25	2.901566	2491	0.961980	1802
	30	2.904063	2497	0.963787	1807
	35	2.906567	2504	0.965598	1811
	40	2.909077	2510	0.967413	1815
	45	2.911594	2517	0.969232	1819
	50	2.914117	2523	0.971056	1824
	55	2.916647	2530	0.972884	1828
142	0	2.919183	2536	0.974716	1832
	5	2.921726	2543	0.976553	1837
	10	2.924276	2550	0.978394	1841
	15	2.926832	2556	0.980239	1845
	20	2.929394	2562	0.982089	1850
	25	2.931964	2570	0.983943	1854
	30	2.934540	2576	0.985802	1859
	35	2.937124	2584	0.987665	1863
	40	2.939714	2590	0.989532	1867
	45	2.942310	2596	0.991404	1872
	50	2.944914	2604	0.993281	1877
	55	2.947525	2611	0.995162	1881
143	0	2.950142	2617	0.997047	1885
	5	2.952767	2625	0.998937	1890
	10	2.955398	2631	1.000832	1895
	15	2.958037	2639	1.002731	1899
	20	2.960682	2645	1.004635	1904
	25	2.963335	2653	1.006544	1909
	30	2.965994	2659	1.008457	1913
	35	2.968661	2667	1.010375	1918
	40	2.971336	2675	1.012297	1922
	45	2.974017	2681	1.014225	1928
	50	2.976706	2689	1.016157	1932
	55	2.979402	2696	1.018094	1937
144	0	2.982105	2703	1.020035	1941
			2711		1947

Angle.		Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle.		Log. Mean Mot.	Diff.	Log. Dist.	Diff.
°	'					°	'				
144	5	2.984816	—2711	1.021982	—1947	148	35	3.143162	—3166	1.134894	—2243
	10	2.987534	2718	1.023933	1951		40	3.146338	3176	1.137143	2249
	15	2.990259	2725	1.025889	1956		45	3.149523	3185	1.139398	2255
	20	2 992992	2733	1.027850	1961		50	3.152718	3195	1.141660	2262
	25	2.995732	2740	1.029816	1966		55	3.155922	3204	1.143928	2268
	30	2.998480	2748	1.031787	1971	149	0	3.159137	3215	1.146202	2274
	35	3.001236	—2756	1.033763	—1976		5	3.162361	—3224	1.148483	—2281
	40	3.003999	2763	1.035743	1980		10	3.165595	3234	1.150771	2288
	45	3 006770	2771	1.037729	1986		15	3.168840	3245	1.153064	2293
	50	3.009548	2778	1.039720	1991		20	3.172094	3254	1.155365	2301
	55	3.012334	2786	1.041716	1996		25	3.175359	3265	1.157672	2307
145	0	3.015128	2794	1.043716	2000		30	3 178633	3274	1.159985	2313
	5	3.017930	—2802	1.045722	—2006		35	3.181918	—3285	1.162306	—2321
	10	3.020739	2809	1.047733	2011		40	3.185214	3296	1.164633	2327
	15	3.023557	2818	1.049749	2016		45	3.188519	3305	1.166966	2333
	20	3.026382	2825	1.051771	2022		50	3.191835	3316	1.169306	2340
	25	3.029215	2833	1.053797	2026		55	3.195162	3327	1.171654	2348
	30	3.032056	2841	1.055829	2032	150	0	3 198499	3337	1.174008	2354
	35	3.034906	—2850	1.057866	—2037		5	3.201846	—3347	1.176368	—2360
	40	3.037763	2857	1 059908	2042		10	3.205204	3358	1.178736	2368
	45	3.040628	2865	1.061955	2047		15	3.208573	3369	1.181111	2375
	50	3.043502	2874	1.064008	2053		20	3.211952	3379	1.183492	2381
	55	3.046384	2882	1.066066	2058		25	3 215342	3390	1.185881	2389
146	0	3.049273	2889	1.068129	2063		30	3.218744	3402	1.188277	2396
	5	3.052171	—2898	1.070198	—2069		35	3.222156	—3412	1.190679	—2402
	10	3.055078	2907	1.072272	2074		40	3.225579	3423	1.193089	2410
	15	3.057993	2915	1.074352	2080		45	3.229013	3434	1.195506	2417
	20	3.060916	2923	1.076437	2085		50	3.232458	3445	1.197930	2424
	25	3.063847	2931	1.078527	2090		55	3.235914	3456	1.200362	2432
	30	3.066787	2940	1.080623	2096	151	0	3.239382	3468	1.202801	2439
	35	3.069736	—2949	1 082725	—2102		5	3.242861	—3479	1.205247	—2446
	40	3.072693	2957	1.084832	2107		10	3.246351	3490	1.207700	2453
	45	3.075658	2965	1.086945	2113		15	3.249853	3502	1.210161	2461
	50	3.078632	2974	1.089063	2118		20	3.253366	3513	1.212630	2469
	55	3.081615	2983	1.091187	2124		25	3.256890	3524	1.215105	2475
147	0	3 084607	2992	1.093316	2129		30	3.260427	3537	1.217589	2484
	5	3.087607	—3000	1.095452	—2136		35	3.263975	—3548	1.220080	—2491
	10	3.090616	3009	1.097593	2141		40	3.267534	3559	1.222578	2498
	15	3.093634	3018	1.099739	2146		45	3.271106	3572	1.225084	2506
	20	3.096661	3027	1.101892	2153		50	3.274689	3583	1.227598	2514
	25	3.099697	3036	1.104050	2158		55	3.278285	3596	1.230120	2522
	30	3.102742	3045	1.106215	2165	152	0	3.281892	3607	1.232650	2530
	35	3.105796	—3054	1.108385	—2170		5	3.285512	—3620	1.235187	—2537
	40	3.108859	3063	1.110561	2176		10	3.289143	3631	1.237732	2545
	45	3.111931	3072	1.112742	2181		15	3.292787	3644	1.240285	2553
	50	3.115012	3081	1.114930	2188		20	3.296443	3656	1.242847	2562
	55	3.118102	3090	1.117124	2194		25	3.300112	3669	1.245416	2569
148	0	3.121202	3100	1.119324	2200		30	3.303793	3681	1.247993	2577
	5	3.124311	—3109	1.121530	—2206		35	3.307486	—3693	1.250579	—2586
	10	3.127429	3118	1.123742	2212		40	3.311192	3706	1.253172	2593
	15	3.130557	3128	1.125960	2218		45	3.314911	3719	1.255774	2602
	20	3.133694	3137	1.128184	2224		50	3.318643	3732	1.258384	2610
	25	3.136840	3146	1.130414	2230		55	3.322387	3744	1.261003	2619
	30	3.139996	3156	1.132651	2237	153	0	3.326145	3758	1.263629	2626
			—3166		—2243				—3770		—2636

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
153	5	3.329915	—3770	1.266265	—2636
	10	3.333698	3783	1.268909	2644
	15	3.337495	3797	1.271561	2652
	20	3.341305	3810	1.274222	2661
	25	3.345128	3823	1.276891	2669
	30	3.348964	3836	1.279569	2678
	35	3.352814	—3850	1.282256	—2687
	40	3.356678	3864	1.284952	2696
	45	3.360555	3877	1.287657	2705
	50	3.364445	3890	1.290370	2713
	55	3.368350	3905	1.293092	2722
154	0	3.372268	3918	1.295824	2732
	5	3.376201	—3933	1.298564	—2740
	10	3.380147	3946	1.301314	2750
	15	3.384108	3961	1.304073	2759
	20	3.388083	3975	1.306841	2768
	25	3.392072	3989	1.309619	2778
	30	3.396076	4004	1.312405	2786
	35	3.400094	—4018	1.315202	—2797
	40	3.404127	4033	1.318007	2805
	45	3.408175	4048	1.320823	2816
	50	3.412237	4062	1.323648	2825
	55	3.416314	4077	1.326482	2834
155	0	3.420406	4092	1.329326	2844
	5	3.424514	—4108	1.332181	—2855
	10	3.428636	4122	1.335045	2864
	15	3.432774	4138	1.337919	2874
	20	3.436927	4153	1.340802	2883
	25	3.441096	4169	1.343696	2894
	30	3.445280	4184	1.346601	2905
	35	3.449480	—4200	1.349515	—2914
	40	3.453696	4216	1.352440	2925
	45	3.457928	4232	1.355375	2935
	50	3.462175	4247	1.358320	2945
	55	3.466439	4264	1.361276	2956
156	0	3.470719	4280	1.364242	2966
	5	3.475016	—4297	1.367219	—2977
	10	3.479329	4313	1.370207	2988
	15	3.483658	4329	1.373205	2998
	20	3.488004	4346	1.376215	3010
	25	3.492367	4363	1.379235	3020
	30	3.496747	4380	1.382266	3031
	35	3.501144	—4397	1.385309	—3043
	40	3.505558	4414	1.388362	3053
	45	3.509989	4431	1.391427	3065
	50	3.514438	4449	1.394503	3076
	55	3.518904	4466	1.397590	3087
157	0	3.523388	4484	1.400689	3099
	5	3.527889	—4501	1.403800	—3111
	10	3.532408	4519	1.406922	3122
	15	3.536946	4538	1.410056	3134
	20	3.541501	4555	1.413201	3145
	25	3.546075	4574	1.416359	3158
	30	3.550668	4593	1.419529	3170
			—4611		—3181

Angle. °	′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
157	35	3.555279	—4611	1.422710	—3181
	40	3.559908	4629	1.425904	3194
	45	3.564556	4648	1.429110	3206
	50	3.569223	4667	1.432328	3218
	55	3.573910	4687	1.435559	3231
158	0	3.578615	4705	1.438802	3243
	5	3.583340	—4725	1.442058	—3256
	10	3.588085	4745	1.445327	3269
	15	3.592849	4764	1.448608	3281
	20	3.597633	4784	1.451903	3295
	25	3.602437	4804	1.455210	3307
	30	3.607260	4823	1.458530	3320
	35	3.612105	—4845	1.461864	—3334
	40	3.616969	4864	1.465211	3347
	45	3.621855	4886	1.468571	3360
	50	3.626760	4905	1.471945	3374
	55	3.631687	4927	1.475333	3388
159	0	3.636635	4948	1.478734	3401
	5	3.641604	—4969	1.482149	—3415
	10	3.646595	4991	1.485578	3429
	15	3.651607	5012	1.489021	3443
	20	3.656640	5033	1.492478	3457
	25	3.661696	5056	1.495950	3472
	30	3.666774	5078	1.499436	3486
	35	3.671873	—5099	1.502936	—3500
	40	3.676995	5122	1.506451	3515
	45	3.682140	5145	1.509981	3530
	50	3.687308	5168	1.513525	3544
	55	3.692499	5191	1.517085	3560
160	0	3.697713	5214	1.520660	3575
	5	3.702950	—5237	1.524249	—3589
	10	3.708210	5260	1.527855	3606
	15	3.713495	5285	1.531476	3621
	20	3.718803	5308	1.535112	3636
	25	3.724135	5332	1.538764	3652
	30	3.729492	5357	1.542432	3668
	35	3.734873	—5381	1.546116	—3684
	40	3.740279	5406	1.549816	3700
	45	3.745710	5431	1.553533	3717
	50	3.751166	5456	1.557266	3733
	55	3.756647	5481	1.561015	3749
161	0	3.762154	5507	1.564782	3767
	5	3.767687	—5533	1.568565	—3783
	10	3.773246	5559	1.572365	3800
	15	3.778831	5585	1.576182	3817
	20	3.784442	5611	1.580017	3835
	25	3.790080	5638	1.583869	3852
	30	3.795745	5665	1.587738	3869
	35	3.801437	—5692	1.591626	—3888
	40	3.807157	5720	1.595531	3905
	45	3.812904	5747	1.599454	3923
	50	3.818679	5775	1.603396	3942
	55	3.824483	5804	1.607356	3960
162	0	3.830315	5832	1.611335	3979
			—5860		—3998

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
162 5	3.836175	—5860	1.615333	—3998	166 35	4.204152	—7924	1.865001	—5353
10	3.842065	5890	1.619349	4016	40	4.212128	7976	1.870389	5388
15	3.847983	5918	1.623385	4036	45	4.220155	8027	1.875810	5421
20	3.853931	5948	1.627440	4055	50	4.228235	8080	1.881266	5456
25	3.859909	5978	1.631514	4074	55	4.236367	8132	1.886756	5490
30	3.865917	6008	1.635608	4094	167 0	4.244553	8186	1.892282	5526
35	3.871955	—6038	1.639722	—4114	5	4.252794	—8241	1.897844	—5562
40	3.878024	6069	1.643856	4134	10	4.261090	8296	1.903443	5599
45	3.884124	6100	1.648010	4154	15	4.269442	8352	1.909078	5635
50	3.890255	6131	1.652185	4175	20	4.277850	8408	1.914750	5672
55	3.896417	6162	1.656380	4195	25	4.286315	8465	1.920460	5710
163 0	3.902611	6194	1.660596	4216	30	4.294838	8523	1.926208	5748
5	3.908837	—6226	1.664833	—4237	35	4.303420	—8582	1.931996	—5788
10	3.915095	6258	1.669091	4258	40	4.312062	8642	1.937822	5826
15	3.921386	6291	1.673371	4280	45	4.320763	8701	1.943688	5866
20	3.927710	6324	1.677672	4301	50	4.329526	8763	1.949595	5907
25	3.934068	6358	1.681996	4324	55	4.338351	8825	1.955542	5947
30	3.940460	6392	1.686341	4345	168 0	4.347239	8888	1.961531	5989
35	3.946885	—6425	1.690709	—4368	5	4.356190	—8951	1.967562	—6031
40	3.953344	6459	1.695099	4390	10	4.365206	9016	1.973635	6073
45	3.959838	6494	1.699512	4413	15	4.374288	9082	1.979752	6117
50	3.966368	6530	1.703948	4436	20	4.383435	9147	1.985913	6161
55	3.972933	6565	1.708407	4459	25	4.392650	9215	1.992118	6205
164 0	3.979533	6600	1.712889	4482	30	4.401934	9284	1.998368	6250
5	3.986170	—6637	1.717396	—4507	35	4.411286	—9352	2.004664	—6296
10	3.992843	6673	1.721926	4530	40	4.420709	9423	2.011006	6342
15	3.999553	6710	1.726481	4555	45	4.430203	9494	2.017396	6390
20	4.006300	6747	1.731060	4579	50	4.439770	9567	2.023833	6437
25	4.013085	6785	1.735663	4603	55	4.449410	9640	2.030319	6486
3	4.019908	6823	1.740292	4629	169 0	4.459124	9714	2.036854	6535
35	4.026769	—6861	1.744946	—4654	5	4.468914	—9790	2.043439	—6585
40	4.033669	6900	1.749626	4680	10	4.478781	9867	2.050075	6636
45	4.040609	6940	1.754331	4705	15	4.488726	9945	2.056763	6688
50	4.047588	6979	1.759062	4731	20	4.498750	10024	2.063503	6740
55	4.054607	7019	1.763820	4758	25	4.508854	10104	2.070295	6792
165 0	4.061667	7060	1.768605	4785	30	4.519040	10186	2.077142	6847
5	4.068768	—7101	1.773416	—4811	35	4.529309	10269	2.084044	—6902
10	4.075910	7142	1.778255	4839	40	4.539662	10353	2.091002	6956
15	4.083095	7185	1.783121	4866	45	4.550100	10438	2.098016	7014
20	4.090322	7227	1.788015	4894	50	4.560626	10526	2.105088	7072
25	4.097591	7269	1.792938	4923	55	4.571240	10614	2.112218	7130
30	4.104904	7313	1.797888	4950	170 0	4.581944	10704	2.119408	7190
35	4.112261	—7357	1.802868	—4980	5	4.592740	10796	2.126658	—7250
40	4.119662	7401	1.807877	5009	10	4.603628	10888	2.133970	7312
45	4.127108	7446	1.812915	5038	15	4.614610	10982	2.141344	7374
50	4.134599	7491	1 817984	5069	20	4.625689	11079	2.148782	7438
55	4.142136	7537	1.823082	5098	25	4.636865	11176	2.156285	7503
166 0	4.149720	7584	1.828211	5129	30	4.648141	11276	2.163853	7568
5	4.157350	—7630	1.833371	—5160	35	4.659518	11377	2.171489	—7636
10	4.165028	7678	1.838562	5191	40	4.670998	11480	2.179192	7703
15	4.172755	7727	1.843785	5223	45	4.682583	11585	2.186965	7773
20	4.180530	7775	1.849040	5255	50	4.694274	11691	2.194809	7844
25	4.188354	7824	1.854328	5288	55	4.706073	11799	2.202725	7916
30	4.196228	7874	1.859648	5320	171 0	4.717983	11910	2.210713	7988
		—7924		—5353			12023		—8064

Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Dist.	Angle. ° ′	Log. Mean Mot.	Diff.	Log. Dist.	Diff.
171 5	4.730000	12023	2.218777	—8064	175 35	5.641401	24304	2.828331	16227
10	4.742144	12138	2.226916	8139	40	5.666171	24770	2.844868	16537
15	4.754398	12254	2.235133	8217	45	5.691424	25253	2.861727	16859
20	4.766771	12373	2.243429	8296	50	5.717178	25754	2.878919	17192
25	4.779266	12495	2.251806	8377	55	5.743454	26276	2.896459	17540
30	4.791884	12618	2.260264	8458	176 0	5.770274	26820	2.914362	17903
35	4.804629	12745	2.268806	—8542	5	5.797661	27387	2.932641	18279
40	4.817502	12873	2.277433	8627	10	5.825639	27978	2.951314	18673
45	4.830506	13004	2.286148	8715	15	5.854233	28594	2.970398	19084
50	4.843645	13139	2.294951	8803	20	5.883472	29239	2.989911	19513
55	4.856919	13274	2.303845	8894	25	5.913384	29912	3.009872	19961
172 0	4.870333	13414	2.312831	8986	30	5.944003	30619	3.030304	20432
5	4.883890	13557	2.321912	—9081	35	5.975361	31358	3.051229	20925
10	4.897591	13701	2.331089	9177	40	6.007496	32135	3.072670	21441
15	4.911441	13850	2.340364	9275	45	6.040446	32950	3.094655	21985
20	4.925443	14002	2.349740	9376	50	6.074254	33808	3.117211	22556
25	4.939599	14156	2.359219	9479	55	6.108965	34711	3.140369	23158
30	4.953913	14314	2.368803	9584	177 0	6.144629	35664	3.164162	23793
35	4.968389	14476	2.378494	—9691	5	6.181299	36670	3.188625	24463
40	4.983031	14642	2.388295	9801	10	6.219035	37736	3.213798	25173
45	4.997842	14811	2.398209	9914	15	6.257900	38865	3.239723	25925
50	5.012826	14984	2.408237	10028	20	6.297962	40062	3.266446	26723
55	5.027986	15160	2.418383	10146	25	6.339298	41336	3.294018	27572
173 0	5.043328	15342	2.428649	10266	30	6.381991	42693	3.322494	28476
5	5.058856	15528	2.439039	10390	35	6.426134	44143	3.351936	29442
10	5.074574	15718	2.449555	10516	40	6.471828	45694	3.382412	30476
15	5.090486	15912	2.460200	10645	45	6.519185	47357	3.413996	31584
20	5.106598	16112	2.470978	10778	50	6.568332	49147	3.446773	32777
25	5.122914	16316	2.481891	10913	55	6.619409	51077	3.480836	34063
30	5.139440	16526	2.492944	11053	178 0	6.672573	53164	3.516289	35453
35	5.156181	16741	2.504140	11196	5	6.728001	55428	3.553253	36964
40	5.173143	16962	2.515483	11343	10	6.785896	57895	3.591860	38607
45	5.190331	17188	2.526976	11493	15	6.846486	60590	3.632263	40403
50	5.207752	17421	2.538624	11648	20	6.910035	63549	3.674638	42375
55	5.225412	17660	2.550430	11806	25	6.976847	66812	3.719188	44550
174 0	5.243317	17905	2.562400	11970	30	7.047273	70426	3.766148	46960
5	5.261474	18157	2.574537	12137	35	7.121727	74454	3.815792	49644
10	5.279890	18416	2.586847	12310	40	7.200699	78972	3.868447	52655
15	5.298574	18684	2.599334	12487	45	7.284771	84072	3.924502	56055
20	5.317532	18958	2.612004	12670	50	7.374647	89876	3.984427	59925
25	5.336772	19240	2.624862	12858	55	7.471189	96542	4.048794	64367
30	5.356304	19532	2.637913	13051	179 0	7.575464	104275	4.118316	69522
35	5.376136	19832	2.651165	13252	5	7.688819	113355	4.193892	75576
40	5.396278	20142	2.664621	13456	10	7.812987	124168	4.276675	82783
45	5.416738	20460	2.678290	13669	15	7.950251	137264	4.368189	91514
50	5.437527	20789	2.692179	13889	20	8.103703	153452	4.470494	102305
55	5.458657	21130	2.706293	14114	25	8.277670	173967	4.586475	115981
175 0	5.480137	21480	2.720641	14348	30	8.478504	200834	4.720368	133893
5	5.501980	21843	2.735230	14589	35	8.716043	237539	4.878730	158362
10	5.524199	22219	2.750069	14839	40	9.006769	290726	5.072549	193819
15	5.546806	22607	2.765167	15098	45	9.381582	374813	5.322426	249877
20	5.569815	23009	2.780532	15365	50	9.909853	528271	5.674608	352182
25	5.593240	23425	2.796174	15642	55	10.812942	903089	6.276668	602060
30	5.617097	23857	2.812104	15930	180 0				
		24304		16227					

TABLE III. *Errors in taking Proportional Parts of the above Parabolick Table.*

Ang. from Per.	Log. M.M.	Ang. by Pro. Par.	Log. of Distance True.	Log. of Distance From M.M.	Log. of Distance Equal Div.	Error.	Diff. too great.
45° 2′ 30″	1.516934	45° 2′ 30″	0.068900	900	900	.000000	
154 57 30	3.418358	154 57 29.9	1.327903	903	904	.000001	
159 57 30	3.695102	159 57 29.8	1.518870	870	872	.000002	
169 57 30	4.576581	169 57 29.7	2.115806	806	813	.000007	1.00002
173 57 30	5.234333	173 57 29.5	2.556394	394	415	.000021	1.00005
174 57 30	5.469352	174 57 29.4	2.713437	437	467	.000030	1.00007
178 57 30	7.522283	178 57 27.0	4.082860	859	3555	.000695	1.00108
179 52 30	10.284669	179 52 4.5	5.924485	486	75638	.051153	1.12500

TABLE IV. *Equation of the Sun's Place, from the Menstrual Parallax.*

Add. s °	Add. s °	☉'s Per. ☽'s Per. ″	☉'s Per. ☽'s Ap. ″	☉'s Ap. ☽'s Per. ″	☉'s Ap. ☽'s Ap. ″	Substract. s °	Substract. s °
0 0	6 0	0	0	0	0	6 0	12 0
5	25					5	25
10	20	3	3	2	3	10	20
15	15					15	15
20	10	5	6	5	6	20	10
25	5					25	5
1 0	5 0	8	9	7	8	7 0	11 0
5	25					5	25
10	20	10	12	10	11	10	20
15	15					15	15
20	10	12	14	11	13	20	10
25	5					25	5
2 0	4 0	13	15	13	14	8 0	10 0
5	25					5	25
10	20	14	16	14	15	10	20
15	15					15	15
20	10	15	17	14	16	20	10
25	5					25	5
3 0	3 0	15	17	15	17	9 0	9 0

TABLE V. *Increase or Decrease of the Earth's Dist. from the Sun, from the Menstrual Parallax.*

Add. s °	Add. s °	☽'s Par. 54′	55′	56′	57′	58′	59′	60′	61′	Substract. s °	Substract. s °
0 0	12 0	0.0000795	780	766	753	740	727	715	703	6 0	6 0
5	25	0.0000791	777	763	750	737	724	712	701	5	25
10	20	0.0000783	768	755	741	729	716	704	693	10	20
15	15	0.0000767	753	740	727	714	702	691	679	15	15
20	10	0.0000747	733	720	707	695	683	672	661	20	10
25	5	0.0000720	707	694	682	671	659	648	638	25	5
1 0	11 0	0.0000688	675	663	652	641	630	619	609	7 0	5 0
5	25	0.0000651	639	628	617	606	596	586	576	5	25
10	20	0.0000609	598	587	577	567	557	548	539	10	20
15	15	0.0000562	552	542	532	523	514	506	497	15	15
20	10	0.0000511	501	492	484	476	467	460	452	20	10
25	5	0.0000456	447	439	432	424	417	410	403	25	5
2 0	10 0	0.0000397	390	383	376	370	364	358	352	8 0	4 0
5	25	0.0000336	330	324	318	313	307	302	297	5	25
10	20	0.0000272	267	262	257	253	249	245	241	10	20
15	15	0.0000206	202	198	195	191	188	185	182	15	15
20	10	0.0000138	135	133	131	128	126	124	122	20	10
25	5	0.0000069	068	067	066	064	063	062	061	25	5
3 0	9 0	0.0000000	000	000	000	000	000	000	000	9 0	3 0

Tables IV. and V. are to be thus used: From the moon's place substract the sun's, and against the remainder in table IV. is the angle CSE (fig. 6.) to be added to, or substracted from the sun's place as found by the common tables. Against the remainder in table V. is given the length of the line ED in parts of the earth's mean distance, to be added to, or substracted from the distance of the earth from the sun, which the tables of the sun give.

TAB. VI. *Decimals of a Degree reduced to Minutes and Seconds.*

	″		′ ″		′ ″
.001	3.6	.01	0 36	.1	6 0
.002	7.2	.02	1 12	.2	12 0
.003	10.8	.03	1 48	3	18 0
.004	14.4	.04	2 24	.4	24 0
.005	18.0	.05	3 0	.5	30 0
.006	21.6	.06	3 36	.6	36 0
.007	25.2	07	4 12	.7	42 0
.008	28.8	.08	4 48	.8	48 0
.009	32.4	.09	5 24	.9	54 0

TABLE VII. *Decimals of a Day reduced to Hours, Minutes, and Seconds.*

	″		′ ″		′ ″		h ′ ″		h ′ ″
.00001	0.864	.0001	0 8.64	.001	1 26.4	.01	0 14 24	.1	2 24 0
.00002	1.728	.0002	0 17.28	.002	2 52.8	.02	0 28 48	.2	4 48 0
.00003	2.592	.0003	0 25.92	.003	4 19.2	.03	0 43 12	.3	7 12 0
.00004	3.456	.0004	0 34.56	.004	5 45.6	.04	0 57 36	.4	9 36 0
.00005	4.320	.0005	0 43.20	.005	7 12.0	.05	1 12 0	.5	12 0 0
.00006	5.184	.0006	0 51.84	.006	8 38.4	.06	1 26 24	.6	14 24 0
.00007	6.048	.0007	1 0.48	.007	10 4.8	.07	1 40 48	.7	18 48 0
.00008	6.912	.0008	1 9.12	.008	11 31.2	.08	1 55 12	.8	19 12 0
.00009	7.776	.0009	1 17.76	.009	12 57.6	.09	2 9 36	.9	21 36 0

TABLE VIII.

Days Mot.	Comet 1680. Ang. from Per. °	′	″	Dist. fr. ☉	Ordinate.	Comet 1682. Ang. from Per. °	′	″	Dist. fr. ☉
1/4	132	58	6	0.03847	0.02815				
1/2	143	53	13	0.06375	0.03757				
1	151	56	38	0.10425	0.04903				
2	158	1	52	0.16874	0.06312				
3	160	54	58	0.22289	0.07287				
4	162	42	52	0.27124	0.08059	12	26	46	0.59022
8	166	21	18	0.43402	0.10239	24	16	54	0.61027
12	168	6	23	0.57059	0.11760	35	10	54	0.64192
16	169	12	25	0.69249	0.12968	44	54	55	0.68294
20		59	19	0.80453	0.13986	53	27	18	0.73117
24	170	35	4	0.90929	0.14875	60	53	1	0.78470
28	171	3	36	1.00836	0.15670	67	20	5	0.84204
32		27	7	1.10281	0.16392	72	56	25	0.90196
36		47	0	1.19339	0.17055	77	50	28	0.96361
40	172	4	8	1.28067	0.17671	82	8	50	1.02634
44		19	6	1.36508	0.18247	85	57	18	1.08969
48		32	21	1.44697	0.18789	89	20	35	1.15334
52		44	12	1.52661	0.19301	92	22	36	1.21703
56		55	7	1.60424	0.19777	95	6	32	1.28059
60	173	4	36	1.68003	0.20251	97	34	58	1.34390
64		13	28	1.75416	0.20696	99	50	6	1.40686
68		21	39	1.82676	0.21120	101	53	41	1.46943
72		29	12	1.89796	0.21529	103	47	13	1.53154
76		36	13	1.96783	0.21923	105	31	54	1.59316
80		42	44	2.03651	0.22304	107	8	50	1.65430
84		48	51	2.10403	0.22672	108	38	53	1.71491
88		54	35	2.17050	0.23028	110	2	49	1.77501
92		59	59	2.23597	0.23373	111	21	16	1.83461
96	174	5	4	2.30049	0.23709	112	34	48	1.89368
100		9	53	2.36413	0.24036	113	43	54	1.95225
104		14	27	2.42692	0.24354	114	49	0	2.01032
108		18	46	2.48892	0.24665	115	50	27	2.06791
112		22	54	2.55005	0.24965	116	48	35	2.12501
116		26	50	2.61065	0.25261	117	43	42	2.18163
120		30	35	2.67046	0.25550	118	36	2	2.23779

TABLE IX. *Abscissa and Ordinate of a Parabola at different Angles from the Vertex.*

Angle	Abscissa.	Ordinate.	Angle	Abscissa.	Ordinate.
10°	0.00765	0.17498	130°	4.59891	4.28901
20	0.03109	0.35265	140	7.54863	5.49495
30	0.07180	0.53590	150	13.92821	7.46410
40	0.13247	0.72794	160	32.16343	11.34254
50	0.21744	0.93261	170	130.64610	22.86011
60	0.33333	1.15470	175	524.58248	45.80752
70	0.49029	1.40042	176	820.03500	57.27250
80	0.70409	1.67820	177	1458.35842	76.37693
90	1.00000	2.00000	178	3282.13970	114.57992
100	1.42028	2.38351	179	13130.55876	229.17730
110	2.03961	2.85630	179½	52524.23496	458.36332
120	3.00000	3.46410	179¾	210098.93985	916.73103

TABLE X.

Hourly Motion of Comets.

Perih. Dist.	Parts of M. O.	Miles.
Comet 1680	.012952	997000
0.1	.003205	247000
0.2	.002267	175000
0.3	.001851	143000
0.4	.001603	123000
0.5	.001434	110000
0.6	.001309	101000
0.7	.001212	93000
0.8	.001133	87000
0.9	.001068	82000
1.0	.001014	78000
1.5	.000828	64000
2.0	.000717	55000
2.5	.000641	49000
3.0	.000585	45000
3.5	.000542	42000
4.0	.000507	39000

Time from Perih. to Lat. rect.

	Dec. of Days.	d	h	′	″
Comet 1680	0.052545	0	1	15	40
0.1	3.46635	3	11	11	32
0.2	9.80430	9	19	18	12
0.3	18.01165	18	0	16	46
0.4	27.73076	27	17	32	16
0.5	38.75490	38	18	7	4
0.6	50.94464	50	22	40	17
0.7	64.19757	64	4	44	30
0.8	78.43440	78	10	25	33
0.9	93.59129	93	14	11	27
1.0	109.61543	109	14	46	13
1.5	201.3764	201	9	2	
2.0	310.0392	310	0	56	
2.5	433.2929	433	7	2	
3.0	569.5785	569	13	53	
3.5	717.7507	717	18	1	
4.0	876.9232	876	22	9	

TABLE XI.

Apparent Motion of the Comet of 1682, at its next Return, whatever Month of the Year its Perihelion happens in.

Perihelion April 20.

Time.	Long.	Lat.	Curt. Dist.
Apr. 20	♈ 1.8	N. 8.2	1.18
30	3.3	9.1	0.80
May 10	11.9	9.8	0.41
20	♋ 2.2	1.5	0.17
30	♌ 26.5	S. 7.1	0.48
June 9	♍ 6.7	8.1	0.85

Perihelion May 21.

Time.	Long.	Lat.	Curt. Dist.
May 11	♈ 23.2	N. 8.5	1.29
21	26.2	10.8	0.90
31	♉ 12.3	14.4	0.50
June 10	♋ 15.1	12.1	0.32
20	♌ 28.3	0.4	0.60
30	♍ 10.8	S. 3.5	0.97

Perihelion June 21.

Time.	Long.	Lat.	Curt. Dist.
June 11	♉ 15.9	N. 10.7	1.01
21	♊ 1.2	15.3	0.62
July 1	♋ 20.4	17.0	0.42
11	♍ 4.7	6.0	0.65
21	19.1	0.2	1.02

Perihelion July 23.

Time.	Long.	Lat.	Curt. Dist.
July 3	♊ 2.6	N. 9.7	1.10
13	16.0	15.1	0.80
23	♋ 27.7	20.4	0.45
Aug. 2	♍ 15.9	11.1	0.56
12	♎ 1.5	3.9	1.03

Perihelion August 22.

Time.	Long.	Lat.	Curt. Dist.
July 23	♊ 12.9	N. 8.8	1.13
Aug. 2	26.3	13.9	0.75
12	♌ 0.7	22.8	0.45
22	♍ 26.0	16.5	0.58
Sept. 1	♎ 15.1	7.8	0.95

Perihelion September 23.

Time.	Long.	Lat.	Curt. Dist.
Aug. 14	♊ 23.9	N. 7.4	1.09
24	♋ 4.5	13.2	0.71
Sept. 3	♌ 8.3	25.4	0.39
13	♎ 12.3	22.0	0.47
23	♏ 4.1	11.4	0.85

Perihelion October 23.

Time.	Long.	Lat.	Curt. Dist.
Sept. 3	♊ 29.2	N. 6.3	1.01
13	♋ 7.6	13.0	0.62
23	♌ 9.3	31.0	0.28
Oct. 3	♏ 6.0	28.7	0.34
13	26.8	14.6	0.73
23	♐ 0.2	8.7	1.12

Perihelion November 22.

Time.	Long.	Lat.	Curt. Dist.
Sept. 13	♊ 27.7	N. 2.6	1.25
23	29.8	5.2	0.88
Oct. 3	♋ 1.9	12.6	0.50
13	12.	51.	0.11
15	♌ 7.	74.	0.04
16	♎ 16.	78.	0.03
23	♐ 23.	31.	0.28
Nov. 2	25.6	15.8	0.66
12	24.5	10.2	1.03

Perihelion December 21.

Time.	Long.	Lat.	Curt. Dist.
Oct. 2	♊ 26.7	N. 0.7	1.12
12	23.0	3.5	0.77
22	11.1	10.7	0.42
Nov. 1	♈ 16.6	28.3	0.21
11	♒ 12.2	20.2	0.39
21	♑ 26.5	13.4	0.70
Dec. 1	20.8	10.5	1.01
Feb. 19	♐ 16.4	S. 9.2	1.13
Mar. 1	3.8	13.8	0.98
11	♏ 19.0	19.1	0.88
21	0.2	23.0	0.83
31	♎ 12.4	23.8	0.91

Perihelion January 20.

Time.	Long.	Lat.	Curt. Dist.
Oct. 12	♊ 24.3	S. 2.3	1.31
22	18.7	1.1	0.99
Nov. 1	6.8	N. 1.2	0.71
11	♉ 6.4	5.2	0.51
21	♈ 4.2	9.2	0.50
Dec. 1	♓ 8.8	9.5	0.66
11	♒ 25.0	9.2	0.89
21	16.9	8.5	1.11
Mar. 1	♑ 9.5	S. 3.4	1.02
11	0.2	8.7	0.80
21	♐ 12.9	16.4	0.62
31	♏ 13.3	24.2	0.54
Apr. 10	♎ 13.0	25.6	0.63
20	♍ 24.9	22.5	0.85
30	16.7	19.5	1.13

Perihelion February 19.

Time.	Long.	Lat.	Curt. Dist.
Nov. 1	♊ 15.7	S. 4.1	1.21
11	4.6	3.1	0.98
21	♉ 18.6	1.3	0.83
Dec. 1	♈ 26.9	N. 1.0	0.78
11	8.0	3.2	0.86
21	♓ 24.8	4.6	1.00
Mar. 11	♒ 10.9	3.6	1.10
21	4.8	0.4	0.83
31	♑ 24.0	S. 6.3	0.54
Apr. 10	♐ 22.2	22.2	0.30
20	♎ 17.1	29.2	0.33
30	♍ 21.3	21.7	0.61
May 10	12.9	17.8	0.93

Perihelion March 20.

Time.	Long.	Lat.	Curt. Dist.
Nov. 30	♉ 21.2	S. 3.3	1.13
Dec. 10	7.2	2.7	1.09
20	♈ 24.3	1.0	1.14
Mar. 30	♓ 6.5	N. 7.0	1.18
Apr. 9	3.9	4.7	0.76
19	♒ 29.0	0.8	0.40
29	♑ 22.	S. 50.	0.05
30	♐ 11.	62.	0.04
May 9	♒ 10.8	20.1	0.33
19	8.6	14.8	0.70
29	9.0	13.8	1.07

TABLE XII.

Place where the Comet of 1682 may be first expected to appear any Month.

		Longitude.		Latitude.	Dist. from Perihelion.	Bearing and Time.
January		Scarce to be seen.				
February	End	Retrog. between	30° and 15° of ♐	Small increasing S.	7 weeks after its perih.	Low S. E. morning.
March	Beginning	——— ———	30 and 15 of ♑	Small N. or S.	A month after perih.	
	End	——— ———	30 and 0 of ♒	Small N. decreasing		
April	Beginning	——— ———	15 and 0 of ♓	Small N. decreasing	2 or 3 weeks after.	Low E. morning.
	End	Stationary	10 ♈ and 20 ♓	Small N.		
May	Beginning	———	Middle of ♈	N.	About the perihelion.	
	End	Direct	Beginning of ♉		1, 2, or 3 weeks before.	
June	Beginning	———	Beginning of ♉	N. increasing		E. morning.
	End	———	End of ♉			N. E. morning.
July	Beginning	———	Beginning of ♊		2, 3, 4, or 5 weeks.	Low N. E. morning.
	End	———	Middle of ♊			
August		———	End of ♊		5, 6, 7, or 8 weeks.	Rises N. E. midnight.
September		Stationary	25 and 30 of ♊	Small increasing N.	2 months before.	——— N. E. at 11.
October		Retrograde	End of ♊	Small S. or N.	2 or 3 months.	——— N. E. at 9
November,	Beginning	———	Beginning of ♊	Small S.	3 months before per.	——— N. E. at 7.
	Middle	———	5 ♊ and 20 ♉	Small S.		——— E. at 5.
	End	———	Beginning of ♉	Small S. or N.		Low E. evening.
December,	Beginning	———	Begin. of ♉, End of ♈	Small S. or N.	11, 12, 13, or 14 weeks.	E. evening.
	End	———	Beginning of ♈	Very faint.		S. E. evening.

ERRATA.

			for	read				for	read
Page 1	Line 7	— —	them selves	themselves	Tab. 1	1718	Col. 7	6° 28′ 50″	6° 28′ 44″
2	12	— —	astronomically	in some measure astronomically	2	64° 15′	2	1.726681	1.726581
					7	Line 7	10	18ʰ 48′	16ʰ 48′
10	Nº. 22	Col. 2	B D D	B D D′	10	0.4		27ᵈ 17ʰ 32′ 16″	27ᵈ 17ʰ 32′ 18″
24	Line 43	— —	I nor can	nor can I	11	Perih. Mar. 20 Line 9		♒ 10.8°	♍ 10.8°

THE INDEX.

THE END.

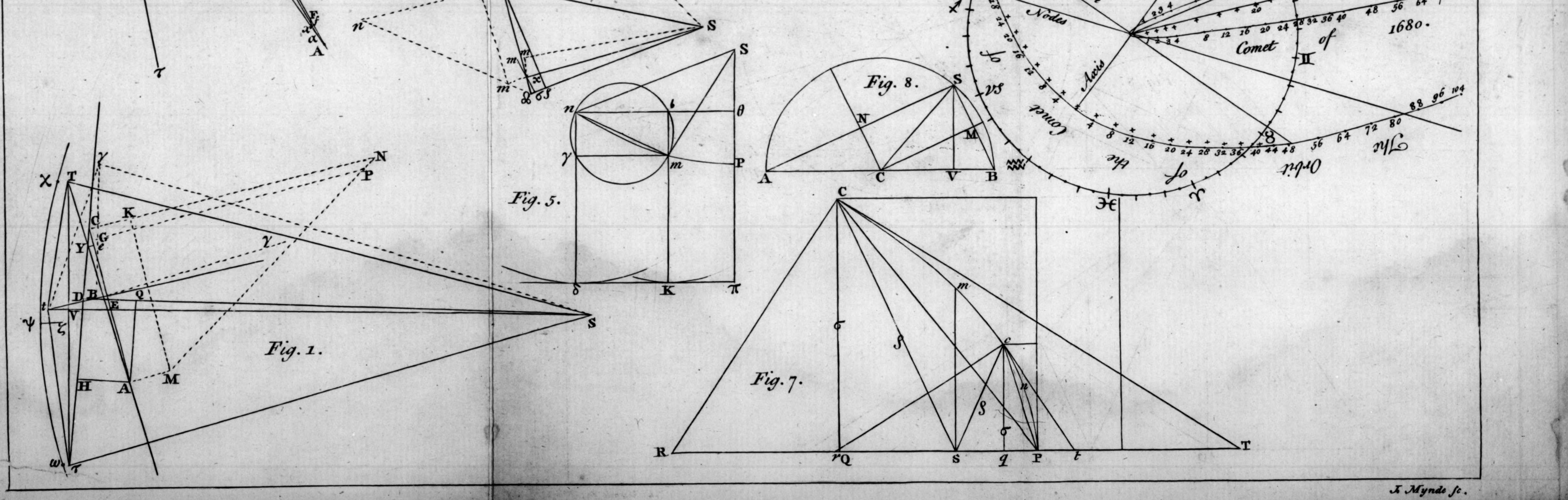

Fig. 1.
Fig. 5.
Fig. 7.
Fig. 8.
Nodes
Axis
The Orbit of the Comet
Comet of 1680.

J. Mynde sc.

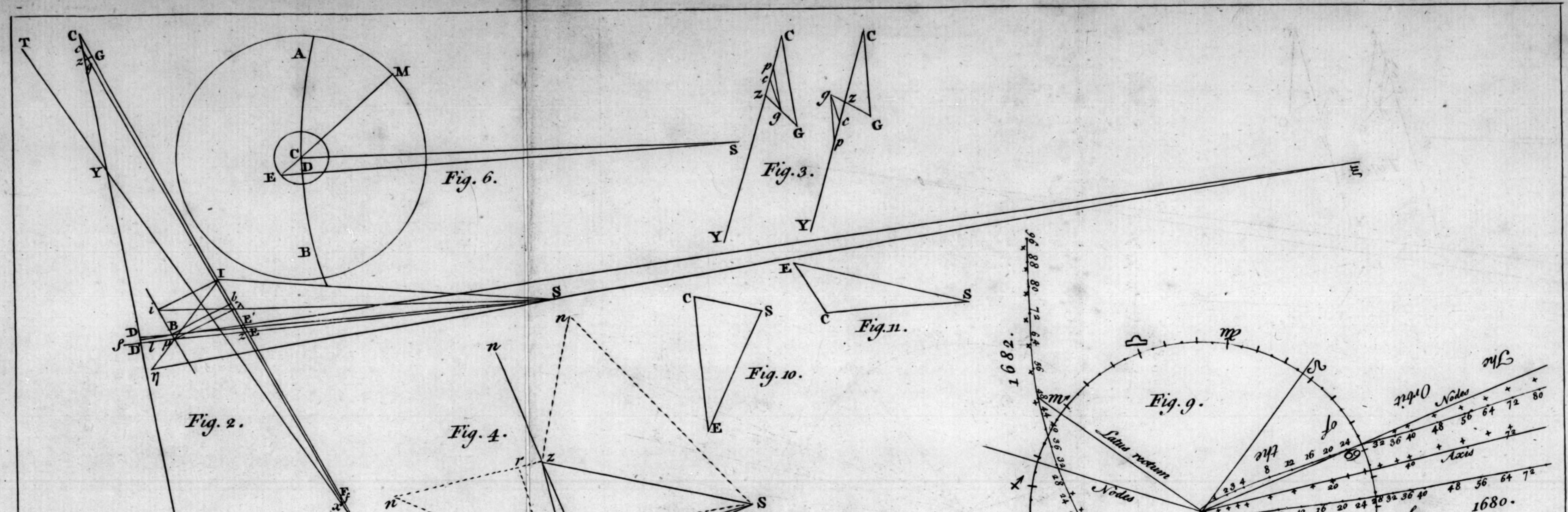

Fig. 2.
Fig. 3.
Fig. 4.
Fig. 6.
Fig. 9.
Fig. 10.
Fig. 11.
1682.
1680.
Latus rectum
Nodes
Axis
The Orbit